Service Manual

Ultra-Low Temperature Freezer

FILE No.

MDF-U55V

SANYO Electric Co., Ltd.
Biomedical Business Division

SM9910253

Effective models

This service manual is effective for following model.

Model	Product code	Voltage and Frequency
MDF-U55V	823 029 54	230/240V 50Hz

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Specifications

Structural specifications

Item	Specifications
Name	Ultra-Low Temperature Freezer
Model	MDF-U55V
External dimensions	W 770 × D 870 × H 1990 (mm)
Internal dimensions	W 630 × D 600 × H 1380 (mm)
Effective capacity	519 L
Exterior	Painted steel
Interior	Painted steel
Outer door	1 door, painted steel
Inner door	2 doors, ABS resin panel with stainless frame
Insulation	VIP（Vacuum insulation panel）＋Rigid polyurethane foamed-in place
Compressor	High stage side：Hermetic rotary type, Output: 450W Low stage side：Hermetic reciprocating type, Output: 750W
Evaporator	High stage side: Cascade condenser Low stage side: Tube on sheet type
Condenser	High stage side：Fin and tube type Low stage side：Cascade condenser
Refrigerant	High stage side：R-404A Low stage side：R-508
Refrigerating oil	Ze-NIUSL22SA
Oil additive	n-pentane
Oil separator	SPK-0S02S2
Shelf	Stainless steel, 3 shelves (adjustable) Inner dimension：W 608 × D 535 (mm) Load：50 kg/shelf
Outer door latch	1pc
Outer door lock	1pc
Caster	4pcs（leveling leg 2pcs. in front side）
Access port	ϕ17mm, 3 locations (back, bottom left, bottom right)
Refrigeration circuit	Cascade system
Power supply	230/240V, 50Hz, Single phase
Weight	288 kg
Battery	Nickel-metal-hydride battery, 6VDC, 1100mAh, Auto-rechargeable (5HR-AAC)
Accessories	1 set of key, 1 scraper
Optional components	Inventory rack (IR-220U, IR-224U), Drawer (MDF-50R), Temperature recorder (MTR-G85/MTR-85H) Back-up system (CVK-UB2): LCO_2, (CVK-UBN2): LN_2 Interface board (MTR-480) Data acquisition system (MTR-5000)

Control specifications

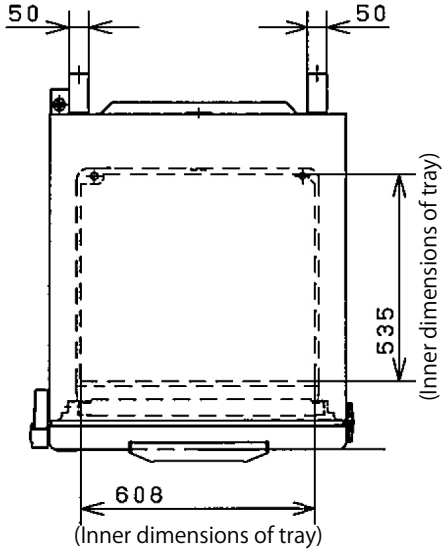
Item	Specifications
Temperature controller	Microcomputer, key-pad input Non-volatile memory
Temperature setting range	-50℃~-90℃ (Unit: 1℃)
Temperature display	LED (Unit: 1℃)
Temperature sensor	Pt. 1000Ω
High temperature alarm	When chamber temperature deviates from set temperature+5℃～+20℃ (Factory default:+10℃), ALARM lamp blinks and buzzer sounds after 15 minutes of delay. Remote alarm contact: Normal Open, Normal close Rated (max) 30VDC, 2A Turns over after 15minutes of delay
Low temperature alarm	When chamber temperature deviates from set temperature-5℃～-20℃ (Factory default:-10℃), ALARM lamp blinks and buzzer sounds after 15 minutes of delay. Remote alarm contact: Normal Open, Normal close Rated (max) 30VDC, 2A Turns over after 15minutes of delay
Filter alarm	FILTER lamp illuminates and buzzer sounds intermittently.
Door alarm	When a door is open, DOOR lamp illuminates after predetermined delay time elapses. (Factory default: 2minutes, Range:1~15minutes)
Power failure alarm	ALARM lamp blinks and buzzer sounds intermittently. Remote alarm activates.
Remote alarm	Allowable contact capacity：DC30V 2A、N.C.-COM, N.O.-COM When temperature alarm or power failure alarm is occurred or any sensor is failed, remote alarm contact turns over.
Notice of battery life	BATTERY lamp illuminates when battery accumulation time (2.8 years) expires.
Notice of condensing fan motor life	BATTERY lamp blinks when condensing fan motor accumulation time (5.6 years) expires.
STATUS function	● Notice of Battery/condensing fan motor life ● Abnormal power supply voltage ● Abnormal ambient temperature ● Overloaded operation
Control panel	Alarm lamp: ALARM Filter check lamp: FILTER Battery check lamp: BATTERY Status monitor lamp: STATUS Door check lamp: DOOR Buzzer stop key: BUZZER Alarm test key: ALARM TEST Status key: STATUS SET：Set key ▶▶: Digit shift key ▲: Numerical value shift key
Key Lock	Press digit shift key for 5 seconds to activate Key Lock mode. L0: Unlock、L1: Lock
Self diagnosis function	When temp. sensor or filter sensor or cascade sensor or AT sensor is failed; Error code is displayed, ALARM lamp illuminates, buzzer sounds and remote alarm is active.

Item	Specifications
Compressor protection	Cascade sensor temperature is higher than －12℃, L side compressor turns off. Cascade sensor temperature is lower than －34℃, L side compressor turns on.
	Overload relay When filter sensor temperature is higher than +60℃, H side compressor turns off. (Substitution for pressure switch)
Compressor delay time	Range: 3~15 minutes (Unit: 1minute) It is not settable delay time individually between H side compressor and L side compressor.

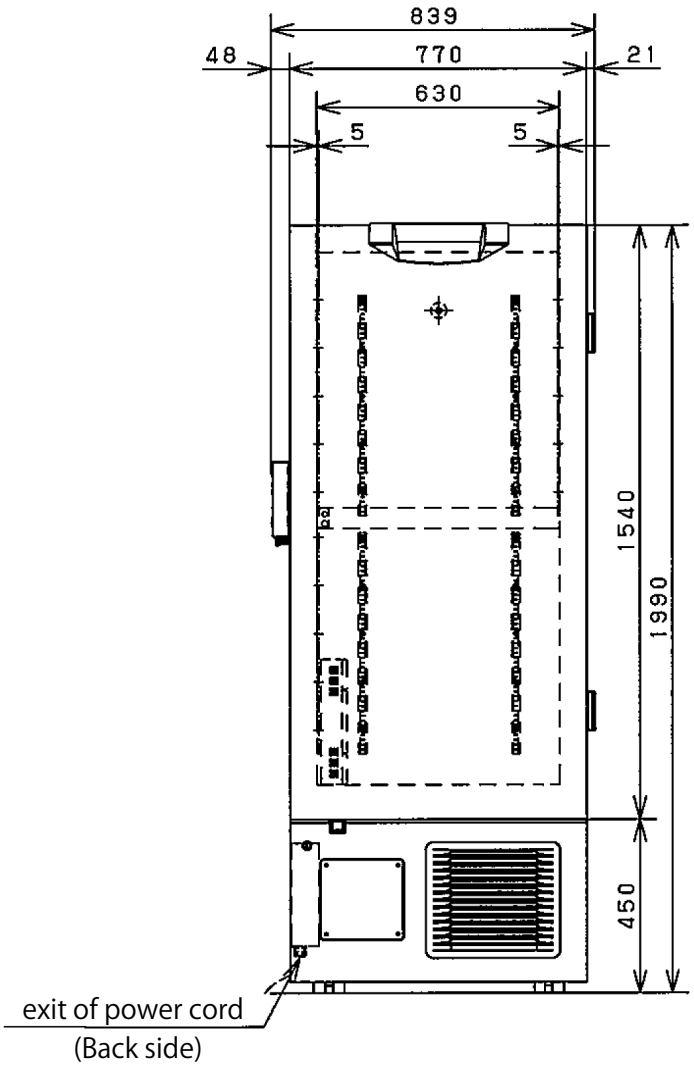
Performance specifications

Item	Specifications	
Maximum cooling performance	-86℃ at the center of the chamber（AT：30℃、No load）	
Temperature control range	－50℃ to －86℃（AT：30℃、No load）	
Power source	230V, 50Hz	240V, 50Hz
Rated power consumption	650W	700W
Noise level	47dB <A> (background noise; 20dB)	
Maximum pressure	2030 kPa	

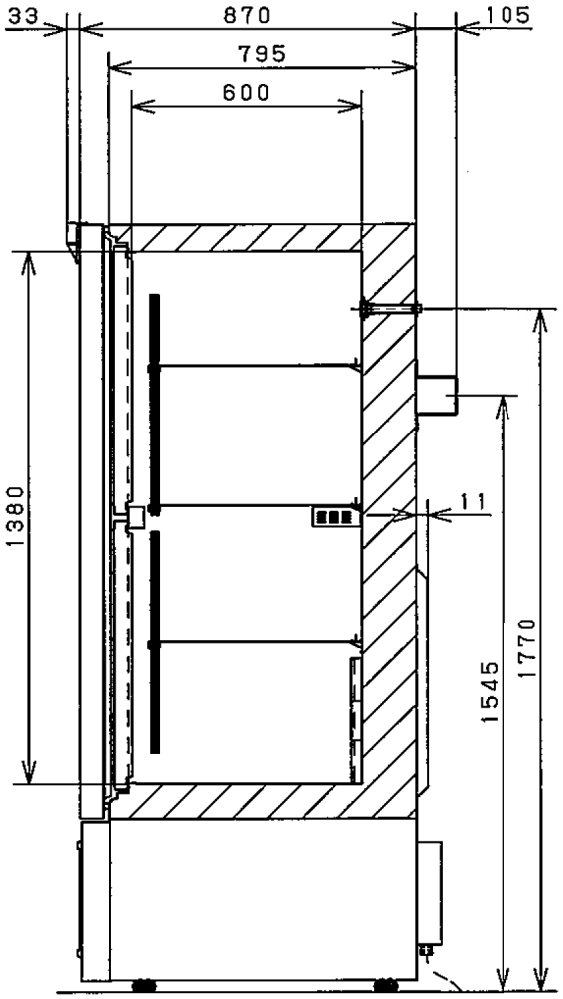
Dimensions



Top

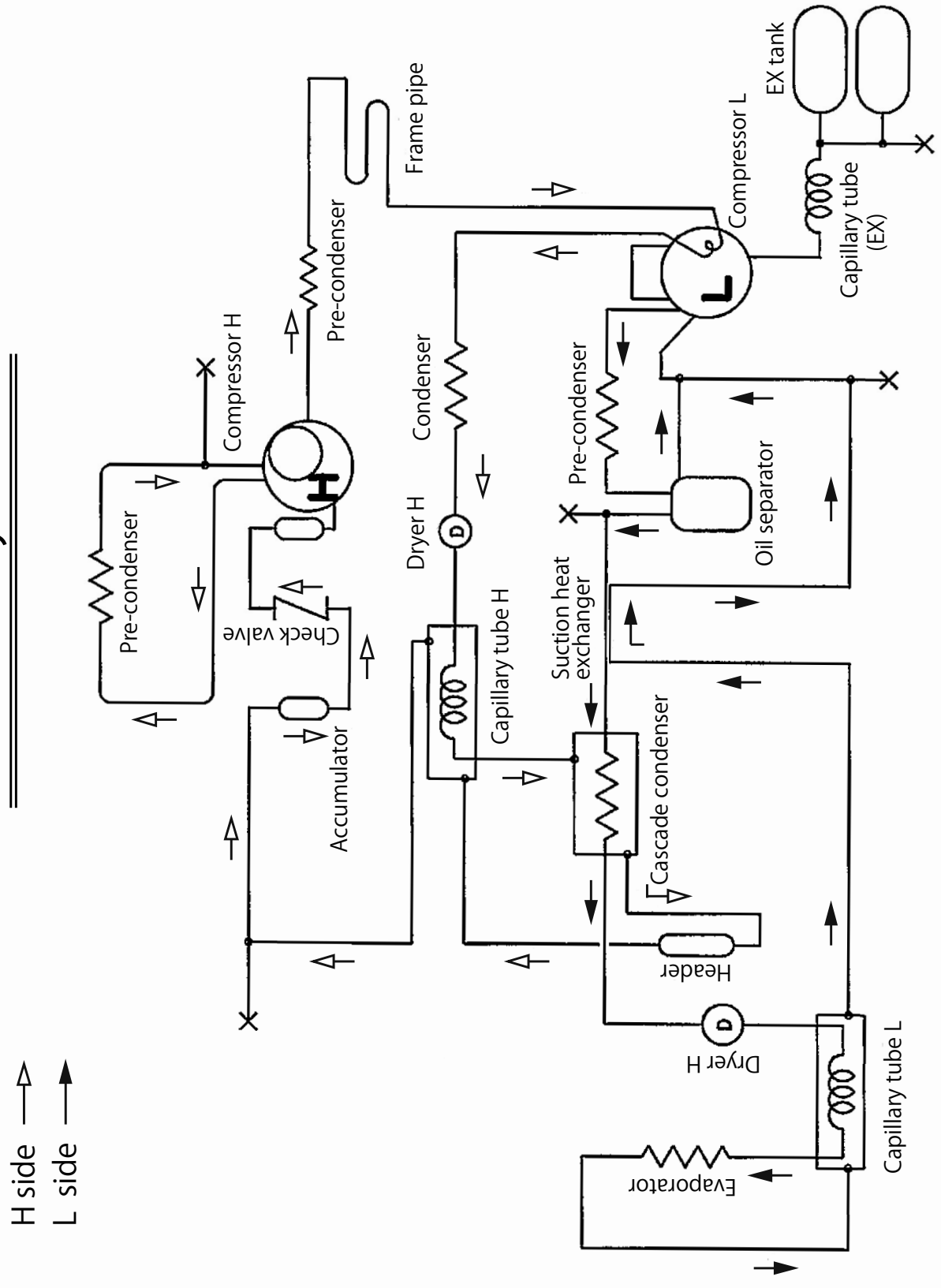


Front



Side

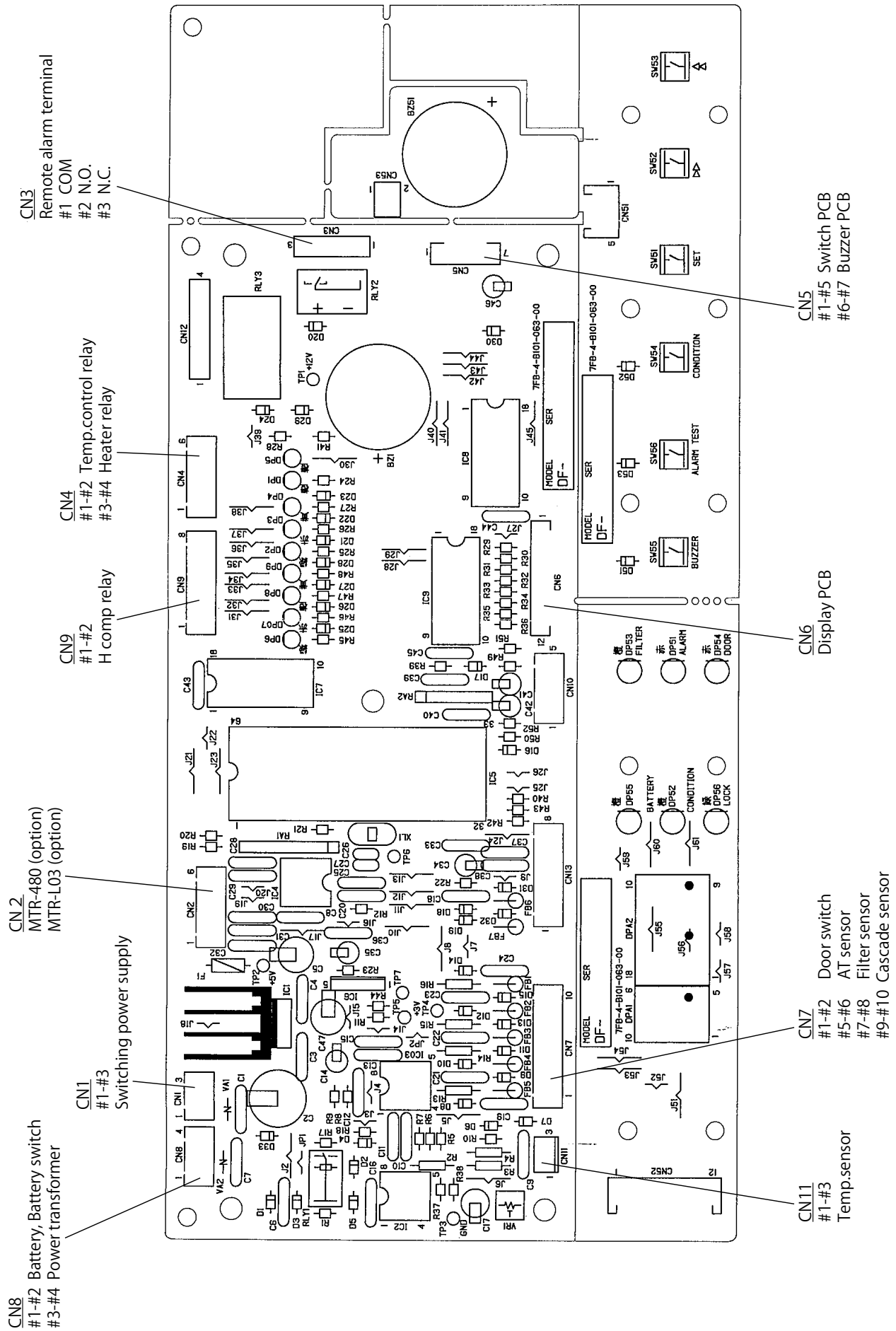
Refrigeration circuit



Cooling unit parts

Parts descriptions	Specifications		
	H side	L side	
Compressor	Type：C-1RN45L5A Code：802 022 15	Type：KS240J1NS-4A1 Code：7FB-0-M101-011-05	
Power supply	Single phase 230/240V, 50Hz	Single phase 230/240V, 50Hz	
Refrigeration oil	Kind：Ze-NIUSL22SA Charged q'ty：230cc	Kind：Ze-NIUSL22SA Charged q'ty：850cc	
Cooling system	Forced air cooling（Partially）， Pre-condenser (DSH)	Forced air cooling（Partially）， Oil cooler (OC)	
Condenser (type)	Fin and tube type	Cascade condenser	
Condenser	P6.35 × 3lines × 12 columns, Fin 38pcs.	Coil pipe (ϕ 6.35mm)	
Pre-condenser	W250 mm	——	
Frame pipe	ϕ 4.76 mm	——	
Evaporator（Type）	Cascade condenser Shell and tube, ϕ 80 mm	Tube on sheet type ϕ 9.52 mm	
Accumulator	ϕ 38 mm		
Capillary tube			Ex. capillary
Resistance	0.765MPa	0.343MPa	34psi
Length L	2000 mm	2500 mm	500 mm
Outside diameter OD	ϕ 2.0 mm	ϕ 2.0 mm	ϕ 2.4 mm
Inside diameter ID	ϕ 0.9 mm	ϕ 0.9 mm	ϕ 1.2 mm
Refrigerant	R-404A Charged q'ty：432g n-Pentane Charged q'ty：18g	R-508 Charged q'ty：370g (TP5R3) n-Pentane Charged q'ty：53g	
Dryer	Type: Dry core (D-SM)	Type: 4A-XH-6 Charged q'ty：58g	
Condensing fan	ϕ 230mm, 4pcs. wings Material：ABS	——	
Condensing fan motor	Type：SV4-11AA5P	——	

Components on PCB



Connections on PCB

The following shows the connections of connectors on the Temp. controller PCB.

Connector	Connects to	Usage
CN1	Switching power supply	To supply the power to PCB.
CN2	Communication kit	To connect to MTR-480/MTR-L03(option).
CN3	Remote alarm terminal #1: COM. #2: N.O. #3: N.C.	Remote alarm contact outputs. In normal condition, open between #1 and #2 and closed between #1 and #3.
CN4	#1-#2：Temp. control relay #3-#4：Heater relay	To control chamber temperature (12VDC) To supply the power to Cap. tube heater (12VDC)
CN5	#1-#5: Switch PCB #6-#7: Buzzer	To connect to each switch To connect to buzzer
CN6	Display PCB	To connect to each LED
CN7	#1-#2: Door switch #5-#6: AT sensor #7-#8: Filter sensor #9-#10: Cascade sensor	To control door open and close To detect ambient temperature To detect temperature in condenser outlet pipe. To detect temperature in cascade.
CN8	#1-#2: Battery（#1:6V　#2:Battery switch） #3-#4: Transformer	To supply the power during power failure To supply the power to PCB.
CN9	#1-#2: H. Comp. relay	To control compressor H ON/OFF (12VDC)
CN10	Unused	
CN11	#1-#3: Temp. sensor	To detect chamber temperature.

Electric Parts

MDF-U55V		AC230/240V, 50Hz
Compressor (H)	Type	C-1RN45L5A
	Code	802 022 15
	Rated voltage (50/60Hz)	220-240V, 50Hz
	Winding resistance C-R(Main)	5.95Ω
	C-S(Aux)	14.76Ω
Compressor (L)	Type	KS240J1NS-4A1
	Code	7FB-0-M101-011-05
	Rated voltage (50/60Hz)	230/240V,50Hz
	Winding resistance C-R(Main)	2.7Ω
	C-S(Aux)	4.9Ω
Starting relay (H)	Type	AMVL-300A
	Pick up voltage	185~217VAC
	Drop out voltage	60~120VAC
Starting relay (L)	Type	AMVL-300TA
	Pick up voltage	205~235VAC
	Drop out voltage	110VAC
Overload relay (L)	Type	MST16AJ120/61-9201
	Action to the temp. (No current)	ON:120℃ OFF:61℃
	Action to the current (AT25℃)	20.5A
	Operation time	6~16sec.
Starting capacitor (H)	Rating	40uF, 300VAC
Starting capacitor (L)	Rating	160uF, 250VAC
Running capacitor (H)	Rating	15uF, 400VAC
Running capacitor (L)	Rating	12uF, 370VAC
Fan motor capacitor	Rating	
Condensing fan motor	Type	SV4-11AA5P
	Rating	220-240V, 10W
Capitube heater	Rating	11.2W, 230V
	Resistance (AT25℃)	4700Ω
Temp. control relay	Type	G4F-11123T
	Contact capacity	20A 250VAC
	Coil	12VDC
Heater relay	Type	G2R-1A-T
	Contact capacity	10A 250VAC
	Coil	12VDC
H. comp relay	Type	G4F-11123T
	Contact capacity	20A 250VAC
	Coil	12VDC
Switching power supply	Type	ZWS10-12/J
	Input	100-240VAC
	Output	12VDC, 0.85A
Battery	Type	5HR-AAC-VIO3
	Rating	6VDC 1100mAH
Temperature sensor	Type	THC-663
	Rating	PT1000Ω
Cascade sensor	Type	502AT-1
	Rating	5KΩ(25℃)
Filter sensor	Type	502AT-1
	Rating	5KΩ(25℃)
AT sensor	Type	502AT-1
	Rating	5KΩ(25℃)
Battery switch	Type	SLE6A2-5
	Rating	250VAC, 4A
Breaker switch	Model	BAM215131
	Rating	250V, 15A
Door switch	Type	SDKNA20700
	Rating	5VDC, 5mA
Transformer	Type	S41-U097PV
	Primary	115V, 230V
	Rating	9VAC, 0.46A
Noise filter	Model	RSAN-2020
	Rating	250VAC, 20A

Specifications of sensor

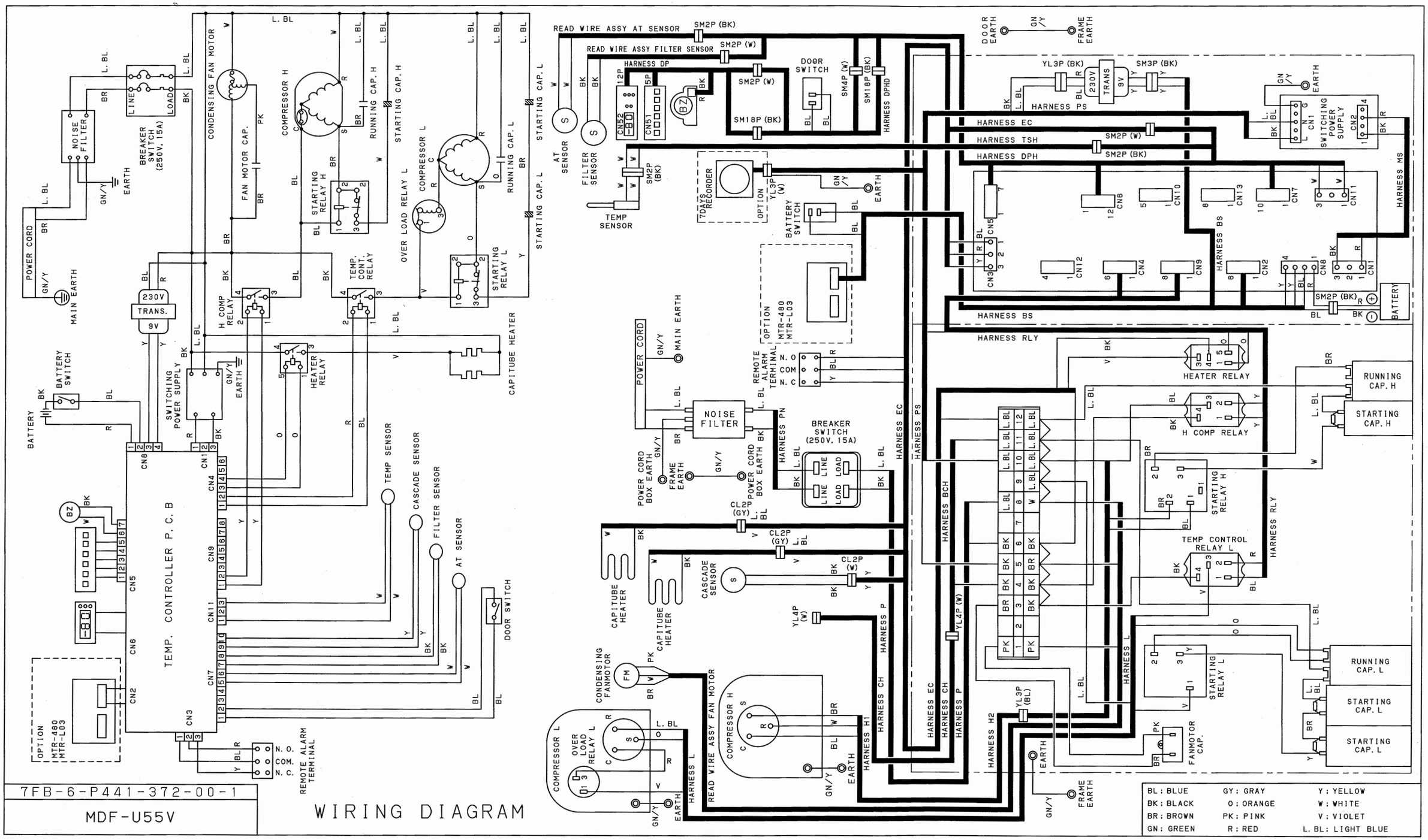
The following shows the temperature in thermal sensor (502AT-1) and its resistance value.

Temp. (C)	Resistance (kΩ)	Temp. (C)	Resistance (kΩ)	Temp. (C)	Resistance (kΩ)	Temp. (C)	Resistance (kΩ)
−50	154.5	−36	71.80	−22	35.65	0	13.29
−49	145.9	−35	68.15	−21	33.99	5	10.80
−48	137.8	−34	64.71	−20	32.43	10	8.84
−47	130.2	−33	61.48	−19	30.92	15	7.20
−46	123.1	−32	58.43	−18	29.50	20	6.01
−45	116.5	−31	55.55	−17	28.14	25	5.00
−44	110.2	−30	52.84	−16	26.87	30	4.17
−43	104.4	−29	50.23	−15	25.65	35	3.50
−42	98.87	−28	47.77	−14	24.51	40	2.96
−41	93.70	−27	45.45	−13	23.42	45	2.51
−40	88.85	−26	43.26	−12	22.39	50	2.13
−39	84.18	−25	41.19	−11	21.41	55	1.82
−38	79.80	−24	39.24	−10	20.48	60	1.56
−37	75.67	−23	37.39	−5	16.43	65	1.35

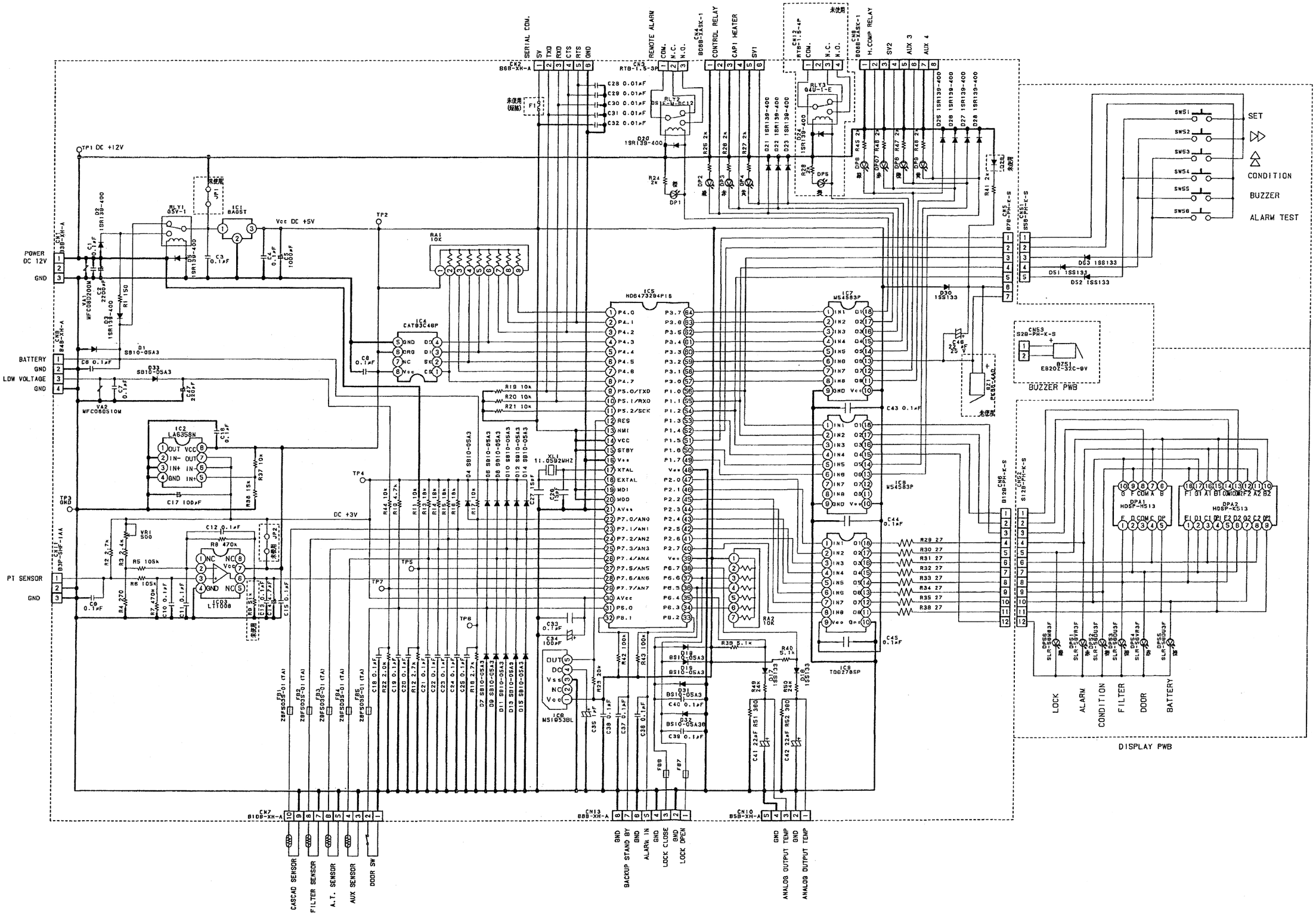
The following shows the temperature in thermal sensor (PT1000Ω) and its resistance value.

Temp. (C)	Resistance (Ω)	Temp. (C)	Resistance (Ω)	Temp. (C)	Resistance (Ω)
−140	450.83	−70	729.99	0	1000.0
−130	491.47	−60	769.02	10	1038.0
−120	531.83	−50	807.87	20	1076.0
−110	571.92	−40	846.58	30	1113.8
−100	611.76	−30	885.13	40	1151.4
−90	651.38	−20	923.55	50	1189.0
−80	690.78	−10	961.84	60	1226.4

Wiring diagram



Circuit diagram



Control specifications

1. Key and Switch

BUZZER	:	In alarm condition, audible alarm silences when this key is pressed. Remote alarm activates and message is not eliminated. When a power failure is occurred (battery back-up), press this key to show a chamber temperature for 5 seconds.
ALARM TEST	:	When this key is pressed, unit steps into Alarm Test mode with ALARM lamp flashes, audible alarm sounds, digital LED is disappeared and remote alarm is active. By Auto Return function, unit will return to normal operation after approx. 90seconds elapse. When an alarm test is performed and a battery switch is in off position, “E09” will flash.
SET	:	Press this key to activate setting mode and 2nd digit will blink on the display. Press this key again to store a value to be changed.
STATUS	:	Press this key when STATUS lamp illuminates to show status code (‘-- 1’, ‘--2’ and ‘--3’) on the display.
▶▶ (Digit shift key)		Every time press this key to blink and change a digit among 1st, 2nd and 3rd digit flexibly. If this key is pressed for 5 seconds when a chamber temperature is displayed, Key Lock is active and “L_0” is displayed.
▲ (Numerical value shift key)		Every time press this key to blink a digit and increase numeric value one by one. If this key is pressed for 5 seconds when a chamber temperature is displayed, Function mode is active and “F00” is displayed.

2. Temperature control

Setting range	:	-50℃~-90℃
Display range	:	-180~50
How to set chamber temperature:		Press SET key and change a value by pressing ▲ key and ▶▶ key. Press SET key again to memorize the value to be changed.
Unacceptable setting range :		The value cannot be changed and audible alarm sounds for 1second, if a value which is out of setting range is input and SET key is pressed.

3. Key Lock mode

Setting range	:	0 (Unlock), 1 (Lock)
How to set Key Lock:		In chamber temperature display, press ▶▶ key for 5 seconds to step to Key Lock mode. (“L_0” or “L_1” is displayed. Factory default: L_0) Change a value by pressing ▲ key and press SET key to memorize the value to be changed.

4. Function mode

Setting range	:	00~50
Display range	:	00~59 00, 16 and 33~43, 44~49, 51~59 are unused.
How to set Function mode :		In chamber temperature display, press ▲ key for 5 seconds to step to Function mode and F00 is displayed. Change a blinking 1st digit by pressing ▲ key and ▶▶ key and press SET key.
Unacceptable setting range :		The value cannot be changed and audible alarm sounds for 1second, if a value which is out of setting range is input and SET key is pressed.

5. Error codes

E01: Temp. sensor is open circuited
E02: Temp. sensor is short circuited
E03: Cascade sensor is open circuited
E04: Cascade sensor is short circuited
E05: Filter sensor is open circuited
E06: Filter sensor is short circuited
E07: AT sensor is open circuited
E08: AT sensor is short circuited
E09: Battery switch is in off position
E10: Compressor temperature is abnormal

(1) Temp. sensor

Open circuit (E01): When a temp. sensor temperature is higher than 50℃, E01 and 50℃ are displayed alternately and audible alarm sounds intermittently and remote alarm contact is active.
Compressor is forcible to turn on.
Press BUZZER key to silence audible alarm.

Short circuit (E02): When a temp. sensor temperature is lower than -170℃, E02 and -170℃~ -180℃ are displayed alternately and audible alarm sounds intermittently and remote alarm contact is active.
Compressor is forcible to turn on.
Press BUZZER key to silence audible alarm.

(2) Cascade sensor

Open circuit (E03): When a temperature in cascade sensor is lower than -65℃, E03 and chamber temperature are displayed alternately, audible alarm sounds intermittently and remote alarm contact is active.
Both High and Low side compressors are turned off.
Press BUZZER key to silence audible alarm.

Short circuit (E04): When a temperature in cascade sensor is higher than 60℃, E04 and chamber temperature are displayed alternately, audible alarm sounds intermittently and remote alarm contact is active.
Both High and Low side compressor are turned off.
Press BUZZER key to silence audible alarm.

(3) Filter sensor

Open circuit (E05): When a filter sensor temperature is lower than -60℃, E05 and chamber temperature are displayed alternately, audible alarm sounds intermittently and remote alarm contact is active.
High side compressor is forcible to turn off.
Press BUZZER key to silence audible alarm.

Short circuit (E06): When a temperature in filter sensor is higher than 130℃, E06 and chamber temperature are displayed alternately, audible alarm sounds intermittently and remote alarm contact is active.
Press BUZZER key to silence audible alarm.

(4) AT sensor

Open circuit (E07): When a temperature in AT sensor is lower than -60℃, E07 and chamber temperature are displayed alternately, audible alarm sounds intermittently and remote alarm contact is active.
Press BUZZER key to silence audible alarm.

Short circuit(E08): When a temperature in AT sensor is higher than 60℃, E08 and chamber temperature are displayed alternately, audible alarm sounds intermittently and remote alarm contact is active.
Press BUZZER key to silence audible alarm.

(5) Battery SW is in off position (E09): If you press ALARM TEST key when battery switch is in off position or battery is unconnected, E09 is displayed.

(6)Compressor abnormal temperature (E10): When a temperature in filter sensor is higher than 60℃, E10 and chamber temperature are displayed alternately and high side compressor is forcibly turned off to notify compressor temperature is abnormal or fan motor is locked.
Press BUZZER key to silence audible alarm.
When the temperature obtained from filter sensor temperature subtracts ambient temperature, is equal or lower than 10℃, compressor will turn on.

(7) Error code priority

No.1: Cascade sensor error (E03, E04) … Compressor is forcible to turn off
No.2: Filter sensor error (E05, E06) … Impossible to protect compressor
No.3: Abnormal compressor temperature(E10) … Compressor temporary turns off
No.4: Temp. sensor error (E01, E02) … Compressor keeps turning on
No.5: AT sensor error (E07, E08) … Warming-up operation is forcible to be active

6. Warning functions

Door alarm : When an outer door leaves open, DP54 (red lamp) illuminates. Audible alarm sounds intermittently after 1~15 minutes (Factory default: 2 minutes) elapse. Audible alarm is not active simultaneously with remote alarm.
Press BUZZER key to silence audible alarm.(Ring Back is not active)

High temp. alarm : When chamber temperature is equal or higher than set temperature + high temp. alarm set temperature +1, ALARM lamp and LED flash, audible alarm sounds intermittently and remote alarm is active after 10 minutes elapse.
When chamber temperature is equal or lower than set temperature, ALARM lamp and LED go off, audible alarm silences, and remote alarm turns off.
Press BUZZER key to silence audible alarm, but not to activate remote alarm simultaneously.

Low temp. alarm : When chamber temperature is equal or lower than set temperature - low temp. alarm set temperature -1, ALARM lamp and LED flash, audible alarm sounds intermittently and remote alarm is active after 10 minutes elapse.
When chamber temperature is equal or higher than set temperature, ALARM lamp and LED go off, audible alarm silences, and remote alarm turns off.
Press BUZZER key to silence audible alarm, but not to activate remote alarm simultaneously.

Power failure alarm : If a power failure is occurred or a power interrupts for 3 seconds when battery switch is in on-position, ALARM lamp blinks, audible alarm sounds intermittently and remote alarm is active.
Press BUZZER key to display chamber temperature for 5 seconds.
When a power returns within 3 seconds since the power was interrupted, microprocessor resets in default settings. Remote alarm is not active.
Press BUZZER key to silence audible alarm, but remote alarm keeps active.
Remote alarm will keep active until chamber temperature is stabled after the power returns from power failure.
When a power interrupts, press BUZZER key to see chamber temperature for 5 seconds.

7. Other functions

Auto Return : If there are not any key operations for 90 seconds when setting mode or Key Lock mode or Function mode is active, unit automatically returns to chamber temperature display.

Ring Back : Audible alarm will sound after predetermined setting time elapses if it is silenced by someone pressing BUZZER key.

Display of sensor temperature:
F12: 3 digits display of temp. sensor temperature (Unit:0.1℃)
(Ex. -80.2℃ → Displayed as '80.2')
F13: 3 digits display of cascade sensor temperature (Unit:1℃)
(Ex. 67℃ → Displayed as '067')
F14: 3 digits display of filter sensor temperature (Unit:1℃)
(Ex. 67℃ → Displayed as '067')
F15: 3 digits display of AT sensor temperature (Unit:1℃)
(Ex. 30℃ → Displayed as '030')

Battery accumulation time :
F03: 3 digits display of battery accumulation time
(Ex. 2years and 6months accumulated → Displayed as '02.5')
When battery accumulation time (2years and 8months, '02.8') expires, BATTERY lamp illuminates.

<Reset of battery accumulation time>
Step to F06 and change a value to '**409**'. Press SET key to reset accumulation time to '00.0'. BATTERY lamp goes off.

Condensing fan motor accumulation time :
F32: 3 digits display of Condensing fan motor accumulation time
(Ex. 5years and 6months accumulated → Displayed as '05.5')
When condensing fan motor accumulation time (5years and 6monts, '05.6') expires, BATTERY lamp flashes.

<Reset of battery accumulation time>
Step to F06 and change a value to '**410**'. Press SET key to reset accumulation time to '00.0'. BATTERY lamp goes off.

Forcible operation of capillary heater:
F18: Compressor is turned off and capillary heater is forcibly to turn on when a value is changed to '000" in F18.
Capillary heater is forcibly to turn off once inputting '000' again during a power conducting to capillary heater.
It is impossible to conduct a power to capillary heater when a value is changed to '001'.
Only compressor will be turned on every 18 hours.

ROM version :
F30: Display of current ROM version
(Ex. Ver. 1.00 → Displayed as "1.00")

8. STATUS function

(1) Display of STATUS code

STATUS lamp illuminates in the following conditions.
STATUS code will be displayed by pressing STATUS key when STATUS lamp illuminates.

STATUS 1: When an ambient temperature is higher than 35.0℃, or lower than 0℃, '--1' is appeared on the display.
STATUS 2: When a power supply voltage is lower than 2.01VDC between TP7 and TP3, '-- 2' is appeared on the display.
STATUS 3: When running rate is higher than 95%, '--3' is appeared on the display.

(2) Display sequence of STATUS code

(Ex.1) When all of three STATUS codes occur simultaneously;

‘ --‘ => ‘-- 1’ => ‘-- 2’ => ‘-- 3’ => ‘--1’ …

(Ex.2) When STATUS 1 and 2 occur simultaneously;

‘ --‘ => ‘-- 1’ => ‘-- 2’ => ‘-- 2’ => ‘--1’ …

When it elapses 90 seconds or when a unit returns from STATUS condition, chamber temperature will be appeared on the display.

9. Running rate

Running rate: Obtained from (ON time / (ON time + OFF time)) x 100%

Definition: “ON time” means the reach time until P3.1 in IC5 is changed “Low” to “Hi”
“OFF time” means the reach time until P3.1 in IC5 is returned “Hi” to “Low”

Condition to measure running rate:
Cycle operation will start when a compressor turns on for the first time after it was turned off when chamber temperature was lower than set temperature.
Running rate will be measured after 2 hours elapse since the unit was stabilized in cycle operation.

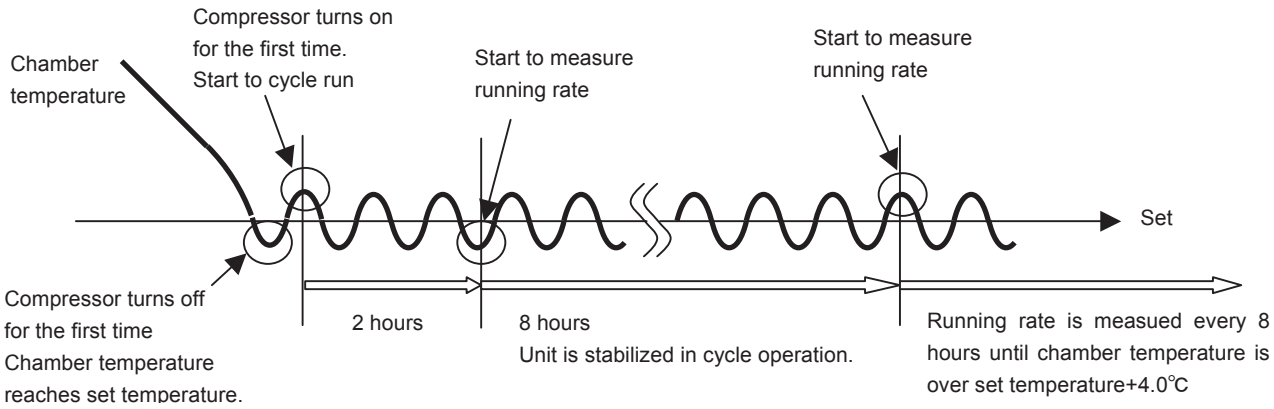
ON time (Min.) = The time until P3.1 in IC5 first reaches from LOW to HIGH
OFF time (Min.) = The time until P3.1 in IC5 reaches from HIGH to LOW

Condition to calculate running rate:

ON time	OFF time	Running rate
= 0	= 0	Impossible to calculate (0%)
> 0	= 0	
= 0	> 0	
> 0	> 0	0 ~ 100%

Note) Running rate cannot be measured when a chamber temperature is higher than set temperature + 4.0℃.
Measuring should be done until a chamber temperature is stabilized.

Diagnosed value of overload running rate:
Step to F20 and input ‘000’.


Chamber temperature
Compressor turns on for the first time. Start to cycle run
Start to measure running rate
Start to measure running rate
Set
Compressor turns off for the first time Chamber temperature reaches set temperature.
2 hours
8 hours
Unit is stabilized in cycle operation.
Running rate is measued every 8 hours until chamber temperature is over set temperature+4.0℃

Diagnosed running rate

=(-(Set temp.)X0.9)+((ATX0.9-4.5℃))-((Set temp.+85℃) / 10))

You can know running status by the calculation for diagnosed running rate.

Diagnosis is done by comparing running rate for 8 hours operation after 2 hours elapses since unit started cycle operation, with diagnosed running rate.

(Diagnosed running rate – running rate) < 0 … Normal (DP52 goes off)

(Diagnosed running rate – running rate) ≧0 … Overload operation (DP52 illuminates)

222 = Running rate cannot be obtained by calculation. (DP52 goes off)

Diagnosis is done in every 8 hours.

10. Function mode

F00	Display of chamber temperature (Unused)
F01	Setting of high temperature alarm
F02	Setting of low temperature alarm
F03	Display of battery accumulation time
F04	Setting of door alarm delay time
F05	Setting of compressor delay time
F06	Setting of service code (Code: 384), Reset of accumulation time
F07 *	Temperature sensor Zero Adjustment
F08 *	Cascade sensor Zero Adjustment
F09 *	Compressor continuous running mode … Factory test mode (Unused)
F10 *	Program running mode … Factory test mode (Unused)
F11 *	PCB test mode … Factory test mode (Unused)
F12 *	Display of temperature in temp. sensor
F13 *	Display of temperature in cascade sensor
F14 *	Display of temperature in filter sensor
F15 *	Display of temperature in AT sensor
F16 *	Display of chamber temperature (Unused)
F17 *	Display of model code and initialization of non-volatile memory
F18 *	Forcible operation for capillary heater
F19 *	Setting of capillary heater ON time … Factory use
F20 *	Setting of diagnosed value of overload running ratio … Factory use
F21	Setting of communication ID
F22	Setting of communication mode
F23 *	Display of power supply voltage
F24	Remote alarm terminal output
F25	Setting of Ring Back time
F26 *	Display of actual operation ratio
F27 *	Display of diagnosed value for overload running ratio
F28 *	Display of delay time of permission to measure running rate (2 hrs timer)
F29 *	Display of delay time of permission to measure running rate (8 hrs timer)
F30 *	Display of ROM version
F31 *	Setting of filter alarm
F32	Display of condensing fan motor accumulation time
F33~F43	Unused
F44 *	Adjustment of power supply voltage display
F45~F49	Unused
F50	Setting of alarm delay time
F51~F59	Unused

Input service code ‘384’ in F06 prior to use function codes which are marked with *.
To cancel service code, input “000” in F06 or turn the power off.

Setting procedure:
In chamber temperature display, press ▲▲ key for 5 seconds to display “F00”.
Input Function code by pressing ▲▲ key and ▶▶ key.
Press SET key to be function mode available.

F00: <Purpose> Simply passing through if entered by mistake.
<Operation> Press SET key in “F00” display to return to chamber temperature display.

F01: <Purpose> Setting of high temperature alarm
<Operation> Input F01 and press SET key to display “015” (Factory default).
Setting range is ‘005~020’.
Change a value by pressing ⏫ key.
Press SET key to memorize the value and to return to chamber temperature display.

F02: <Purpose> Setting of low temperature alarm
<Operation> Input F02 and press SET key to display “-10” (Factory default).
Setting range is “-05”~“-20”.
Change a value by pressing ⏫ key.
Press SET key to memorize the value and to return to chamber temperature display.

F03: <Purpose> Display of battery accumulation time
<Operation> Input F03 and press SET key to display alternately F03 with “00.0” (in case battery used for 36days or less).
Press SET key to return to chamber temperature display.

F04: <Purpose> Setting of door alarm delay time
<Operation> Press SET key in “F04” to display ‘002’ (Factory default).
setting range is ‘001’~’015’.
Change a value by pressing ⏫ key and ⏩ key.
Press SET key to memorize the value and to return to chamber temperature display.

F05: <Purpose> Compressor turns on with delay when a power is supplied or a power returns from a power failure.
<Operation> Input “F05” and press SET key to display ‘003’ (Factory default).
Setting range is ‘003’~’015’. (Unit: Minute)
Change a value by pressing ⏫ key and ⏩ key.
Press SET key to memorize the value and to return to chamber temperature display.

F06: <Purpose> Input of service code and reset of accumulation time
<Operation> Input F06 and press SET key to display ‘000’ (Factory default).
Set service code to “384” by pressing ⏫ key and ⏩ key.
Press SET key to memorize the value and to return to chamber temperature display.
<Reset of battery accumulation time>
Input service code ‘384’ in F06.
Input ‘409’ to reset battery accmulation time and to return to chamber temperature display. (Service code is cancelled)
<Reset of condensing fan motor accumulation time>
Input service code ‘384’ in F06.
Input ‘410’ to reset fan motor accumulation time and to return to chamber temperature display. (Service code is cancelled)
<Cancel> Input F06 again and press SET key to display ‘384’.
Change to ‘000’ by pressing ⏫ key and ⏩ key.
Press SET key to memorize the value and to return to chamber temperature display.
Turn a power off then on to change a value to ‘000’, but it is not stored in non-volatile memory.
Note) Service code ‘384’ is stored in non-volatile memory during battery back-up.

F07: <Purpose> To match a temp. sensor temperature with 1/2H air temperature (Zero calibration of temp. sensor)
<Operation> Input service code in F06 prior to use this mode.
Input F07 and press SET key to display '00.0' (Factory default).
Setting range is '-4.9'~'04.9'.
Change a value by pressing ⏫ key and ⏩ key.
Press SET key to memorize the value and to return to chamber temperature display.

F08: <Purpose> To calibrate a cascade sensor temperature
<Operation> Input service code in F06 prior to use this mode.
Input F08 and press SET key to display '00.0' (Factory default).
Setting range is '-9.9'~'09.9'.
Change a value by pressing ⏫ key and ⏩ key.
Press SET key to memorize the value and to return to chamber temperature display.

F12: <Purpose> To display a temp. sensor temperature
<Operation> Input service code in F06 prior to use this mode.
Input F12 and press SET key to display alternately F12 and "XX.X" (chamber temperature). Press SET key to return to chamber temperature display. Decimal point is displayed in the 3 digits indication, but minus "-" is not displayed.
Ex) "-79.5℃" → Indicated as "79.5"

F13: <Purpose> To display a cascade sensor temperature
<Operation> Input service code in F06 prior to use this mode.
Input F13 and press SET key to display alternately F13 and "XXX" (present temperature in cascade sensor). Press SET key to return to chamber temperature display.

F14: <Purpose> To display a filter sensor temperature
<Operation> Input service code in F06 prior to use this mode.
Input F14 and press SET key to display alternately F14 and "XXX" (present temperature in filter sensor). Press SET key to return to chamber temperature display.

F15: <Purpose> To display an AT sensor temperature
<Operation> Input service code in F06 prior to use this mode.
Input F15 and press SET key to display alternately F15 and "XXX" (present temperature in AT sensor). Press SET key to return to chamber temperature display.

F16: <Purpose> Simply passing through if entered by mistake
<Operation> Press SET key in "F16" to return to chamber temperature display.

F17: <Purpose> Display of model code and initialization of non-volatile memory
<Operation> Service code should be input in F06 prior to use this mode.
Input F17 and press SET key to display '00X'.
Change a value by pressing ⏫ key.
Press SET key to memorize and return to chamber temperature display.
Model code '008': MDF-U55V

<Initial values in non-volatile memory>

Zero Adjustment value for temperature sensor	: 0℃
Zero Adjustment value for cascade sensor	: 0℃
Capillary heater ON time	: 8 minutes
Auto Return	: 30 minutes
Chamber set temperature	: -80℃
Door alarm delay time	: 2 minutes
High temp. alarm	: +10℃
Low temp. alarm	: -10℃
Compressor delay time	: 3 minutes
Communication ID	: 000
Communication mode	: 000
Key Lock	: OFF
Linkage between remote alarm and buzzer	: OFF
Buzzer tone for filter alarm	: OFF
Diagnosed value for STATUS 3	: Fixed

F18: <Purpose> Forcible operation for capillary heater

<Operation> Service code should be input in F06 prior to use this mode.
Input F18 and Press SET key to display '000' (Factory default).
Change to alternative value '000' or '001' by press ⏫ key and ⏩ key.
Press SET key to memorize the value and return to chamber temperature display.
000: Capillary heater is forcibly turned on, or
Capillary heater is forcibly turned off
001: Capillary heater is inoperative

F21: <Purpose> Setting of serial communication ID

<Operation> Input F21 and press SET key to display '000' (Factory default).
Setting range is '001' ~ '255" by pressing ⏫ key and ⏩ key.
Press SET key to return to chamber temperature display.

<Serial communication data>

Data	Display	Unit
Chamber temperature	-180.0 ~ +50.0	℃
Cascade temperature	-68.0 ~ +89.0	℃
Power supply voltage	0.0 ~ 120.0	%
Filter temperature	-68.0 ~ +160.0	℃
Ambient temperature	-68.0 ~ +89.0	℃
Door	0/100	Close/Open
Capillary heater	0/100	Off/On
Compressor H	0/100	Off/On
Compressor L	0/100	Off/On
Power failure	0/100	Off/On
Running ratio	0~100, 222	%
Diagnosed value for overload operation	0~100, 999	%
2H timer counting	0~120	Minute
8H timer counting	0~480	Minute
Set temperature	-90.0~-50.0	℃
High temp. alarm set value	+5.0~+20.0	℃
Low temp. alarm set value	-5.0~-20.0	℃
Filter lamp	0/50	Off/On
Remote alarm	0/50	Off/On
Status lamp	0/50	Off/On
Remote control of set temperature	-90.0~-50.0	℃

F22: <Purpose> Setting of serial communication mode
<Operation> input F22 and press SET key to display '000' (Factory default)
Change a value by pressing ⏫ key and ⏩ key.
Press SET key to memorize the value and return to chamber temperature display.
Control mode (the 3rd digit)
0: Local (initial)
1: Remote
Baud rate (the 2nd digit)
0: 2400bps (initial)
1: 4800bps
2: 9600bps

Note) Setting value cannot be changed at control panel if control mode is set to 'Remote'.

F23: <Purpose> To display a power supply voltage (Unit: %)
<Operation> Service code should be input in F06 prior to use this mode.
Input F23 and press SET key to display alternately F23 with 'xxx' (present power supply voltage). Press SET key to return to chamber temperature display.

F24: <Purpose> Linkage between remote alarm and buzzer
<Operation> Input F24 and Press SET key to display '000' (Factory default).
Change a value by pressing ⏫ key.
Press SET key to memorize the value and return to chamber temperature display.
000: Remote alarm does not link with buzzer
001: Remote alarm links with buzzer

F25: <Purpose> Setting of Ring Back time
<Operation> Input F25 and press SET key to display "030" (Factory default).
Setting range is '000'~'060'.
Change a value by pressing ⏫ key.
Press SET key to memorize the value and to return to chamber temperature display.

000: Not Ring Back
010: 10 minutes
020: 20 minutes
030: 30 minutes
040: 40 minutes
050: 50 minutes
060: 60 minutes

F26: <Purpose> Display of running ratio (Unit: %)
<Operation> Service code should be input in F06 prior to use this mode.
Input F26 and press SET key to display alternately F26 with "XXX" (Present running rate).
Press SET key to return to chamber temperature display.

F27: <Purpose> Display of diagnosed value for overload running ratio
<Operation> Service code should be input in F06 prior to use this mode.
Input F27 and press SET key to display alternately F27 with "XXX" (present diagnosed value for overload running ratio).
'000' is displayed before it accumulates 480 minutes in 8H timer.
Factory default is '095' which is the fixed, except in case diagnosed value is obtained from calculation in F20.
Press SET key to return to chamber temperature display.

F28: <Purpose> Display of delay time to start measuring running ratio
(2hrs timer; 000~120 min)
<Operation> Service code should be input in F06 prior to use this mode.
Input F28 and press SET key to display alternately F28 with 'xxx' (present count value for delay time to start measuring running rate).
Press SET key to return to chamber temperature display.
When a delay time expires (a value reaches to '120'), unit will start measuring running ratio.

F29: <Purpose> Display of delay time to start diagnosing running ratio
(8hrs timer; 000~480 min)
<Operation> Service code should be input in F06 prior to use this mode.
Input F29 and press SET key to display alternately F29 with 'xxx' (present counting value for delay time to start diagnosing running ratio).
Press SET key to return to chamber temperature display.
8hours timer start counting after 2hours timer expires.
When a delay time expires (a value reaches to '480'), unit will start diagnosing running ratio.

F30: <Purpose> ROM version is displayed
<Operation> Service code should be input in F06 prior to use this mode.
Input F30 and press SET key to display alternately F30 with "X.XX" (present ROM version).
Press SET key to return to chamber temperature display.

F31: <Purpose> Setting of buzzer during filter alarm occurs
<Operation> Service code should be input in F06 prior to use this mode.
Input F31 and press SET key to display "001" (Factory default).
Change to alternative value '000' or '001' by pressing ⏫ key.
Press SET key to revert to chamber temperature display.
000: Off
001: On

F32: <Purpose> Display of accumulation time of condensing fan motor
<Operation> Service code should be input in F06 prior to use this mode.
Input F32 and press SET key to display alternately F32 with 'xx.x' (accumulation time).
Press SET key to return to chamber temperature display.

F44: <Purpose> Adjustment for difference of power supply voltage
<Operation> Input F44 and press SET key to display '000' (Factory default).
Setting range is '000'~'003'.
Press SET key to return to chamber temperature display.

Input value	Adjustment of display
000	0% (Power supply voltage is not increased)
001	3% increased
002	5% increased
003	7% increased

F50: <Purpose> Setting of alarm delay time
<Operation> Input F50 and press SET key to display '015' (Factory default).
Setting range is '000'~'015'.
Change a value by pressing ⏫ key and ⏩ key.
Press SET key to memorize the value and to return to chamber temperature display.

11. Compressor control (differential) value

Compressor H:

Turns on when a chamber temperature is set temperature -0.4℃.

Compressor L:

1) Turns on when compressor H turns on and a cascade sensor temperature is -34℃.

2) Turns on after 3 minutes elapse since compressor H turned on

Compressor H, L:

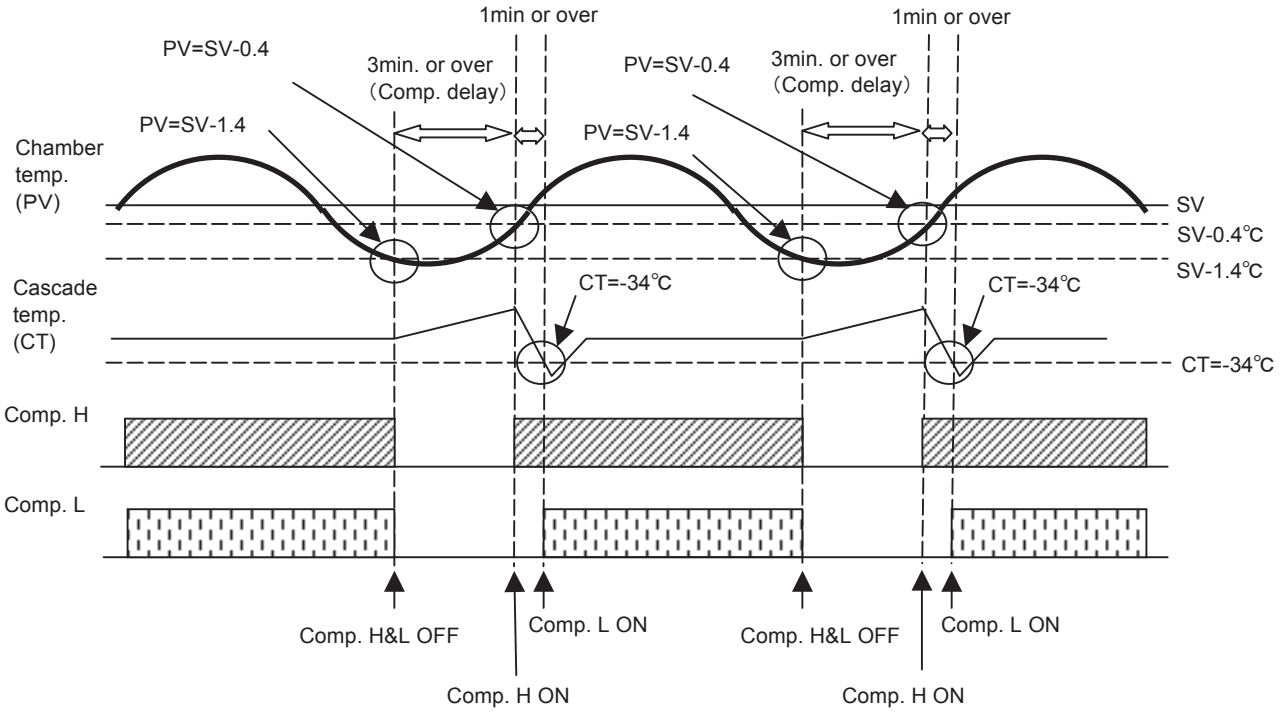
Turns off when a chamber temperature is set temperature -1.6℃

Interval:

1 minute *

* 'Interval' means that a period one of compressor either H or L turns on after another one was turned on.

Note) Compressor L does not turn on until 1 minute elapses since compressor H turned on, if a temperature in cascade sensor is lower than -34℃.



<Operational chart of compressor H/L during cycle>

Protection for compressor H:

Compressor H turns off to prevent it from being warmed up that is caused by fan motor lock.

Filter sensor temperature:

Compressor H turns off when a filter sensor temperature is higher than 60℃. It will turn on again when the filter sensor temperature is lower than ambient temperature +10℃.

12. Delay time

Compressor delay time (Factory default: 3 minutes)
Compressor H or L will be active after predetermined delay time elapses in case it turned off during cycle operation. Compressor delay time is changeable in F05.

Temperature alarm delay time (Factory default: 15 minutes)
When high or low temperature alarm is triggered, buzzer and remote alarm are active after predetermined delay time elapses. Temperature alarm delay time is changeable in F01(high temp. alarm) or F02 (low temp. alarm).
* Note) ALARM lamp illuminates and “F01” or “F02” is displayed without delay.

Door alarm delay time (Factory default: 2 minutes)
When an outer door is ajar, audible alarm sounds after predetermined delay time elapses.
Door alarm delay time is settabled in F04.

Power failure alarm delay time (3 seconds fixed)
When a power is interrupted by power failure, power failure alarm will be occurred after 3 seconds elapses.
Power failure alarm delay time is unchangeable.

13. Prevention for oil logging in capillary

Purpose:
Capillary heater which mounts on capillary is powered and both compressor H and L are turned off to prevent capillary from oil logging.

Action:
Both compressor H and L are turned off and capillary heater relay (CN4: 3-4) is active.

Frequency:
8 minutes in every 18 hours (Setting time are changeable in F19)

Timing of action:
(1) After 9 seconds elapses since both compressor H and L are turned off during cycle operation.
(2) Forcible termination of operation for both compressor H and L if they keep running for 60 minutes after they were ordered to stop operation.

Forcible operation of capillary heater:
Forcible operation of capillary heater is settable in F18.

14. Sensor offset

Offset value:
(1) Temperature sensor: +1.3℃ (Changeable in F07)
(2) Cascade sensor: +/-0.0℃ (Changeable in F08)
(3) Filter sensor: +/-0.0℃
(4) AT sensor: +/-0.0℃

15. Remote alarm terminal

Operation:
When a unit is in alarming condition, remote alarm contact (RLY2) switches the position.

	CN3	
	Between 1 and 2 (N.O.)	Between 1 and 3 (N.C.)
Normal	Open	Close
In alarm	Close	Open

16. Actions and settings after reset

Actions and settings when a power is supplied (Power on reset)

Alarm	Off
Compressor	Off
Remote alarm	Off
Ring Back	30 minutes
Door alarm delay time	2 minutes
Timer	Reset
2H, 8H timer	Reset (0)
Counting time during compressor L is inactive	Reset
Setting data	Read by non-volatile memory

Momentary power interruption:

When a chamber temperature is lower than set temperature+10℃, it is diagnosed that unit is in momentary power interruption.

Actions and settings after unit retrieves from power failure alarm:

Alarm	Off
Compressor	Off
Remote alarm	On
Door alarm delay time	2 minutes
Timer	Reset
2H, 8H timer	Reset (0)
Counting time during compressor L is inactive	Reset
Setting data	Read by non-volatile memory

17. Lamp and display

Lamp specifications:

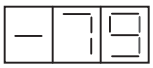
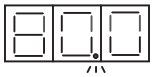
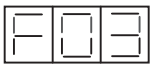
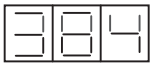
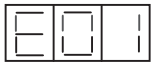
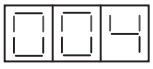
<Control PCB>

Lamp	Color	Lamp status	Unit status
DP1	Orange	On	Not in alarm
		Off	High/low temp. alarm, sensor failure, power failure
DP2	Green	On	Compressor L is active
		Off	Compressor L is inactive
DP3	Red	On	Capillary heater is active
		Off	Capillary heater is inactive
DP4	(Unused)		
DP6	Green	On	Compressor H is active
		Off	Compressor H is inactive

<Display PCB>

Lamp	Color	Lamp status	Unit status
DP51	Red	Flash	Alarming
DP52	Green	On	Status 1 or 2 or 3 is occurred
DP53	Orange	On	Filter alarm is occurred
DP54	Red	On	Door is ajar
DP55	Orange	On	Notice of battery life
		Flash	Notice of fan motor life
DP56	(Unused)		

Examples of display:

Chamber temp.	-79.5℃		Decimal point of chamber temp.	-80.0	
Set temp.	-80.0℃		Sensor offset	-5.0	
Function	F03		Operation monitoring	LCP	
Service code	384		Error	E01	
Set value	004		Accumulation time	8H timer 135	
Key Lock	L_0				

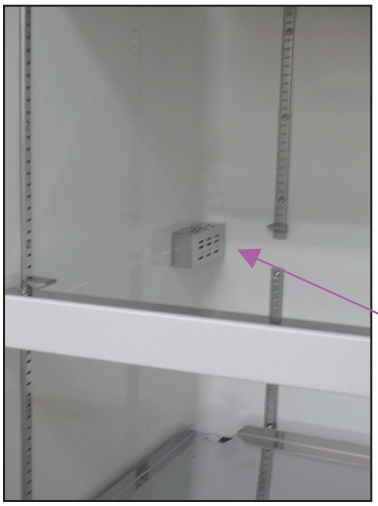
Buzzer tone:

Alarms (except door alarm)	Intermittent tone
Key operation	Click tone
Set value memory	Click tone
Out of settable range	Continuous tone (1 second)
Door alarm	Intermittent tone (Shorter interval than other alarms)

Parts layout

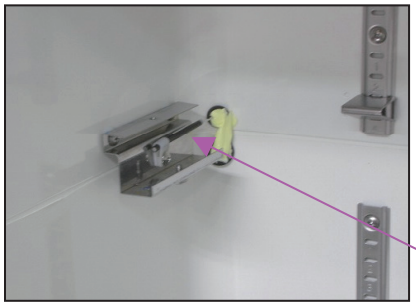
Control panel

Inner door handle



Temp. sensor with cover

Door latch "Close"



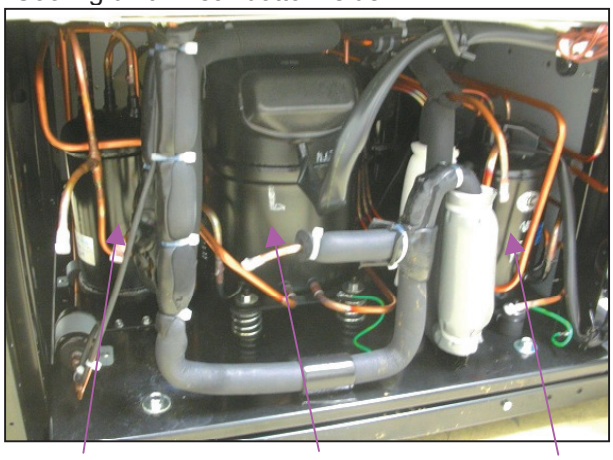
Temp. sensor
without cover

Door latch "Open"

Filter

AT sensor

<Cooling unit - Rear bottom side>

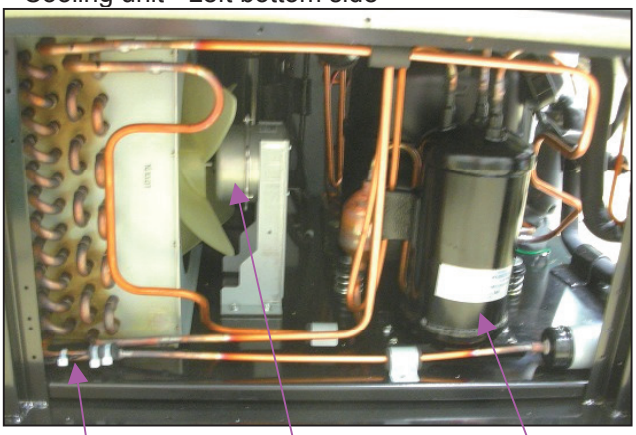


Oil separator

Compressor L

Compressor H

<Cooling unit - Left bottom side>

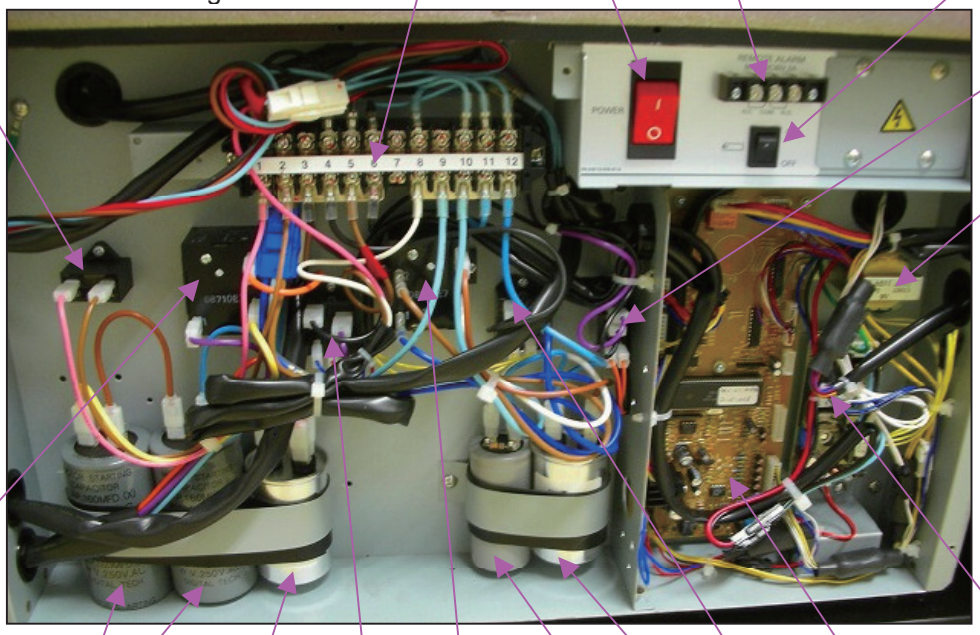


Condensing fan motor

Oil separator

Filter sensor

<Electric Box - Right bottom side>



Fan motor condenser

12P terminal

Remote alarm terminal

Breaker switch

Battery switch

Heater relay

Transformer

Starting relay L

Starting capacitor L

Running capacitor L

Temp. control relay

Starting relay H

Starting capacitor H

H comp relay

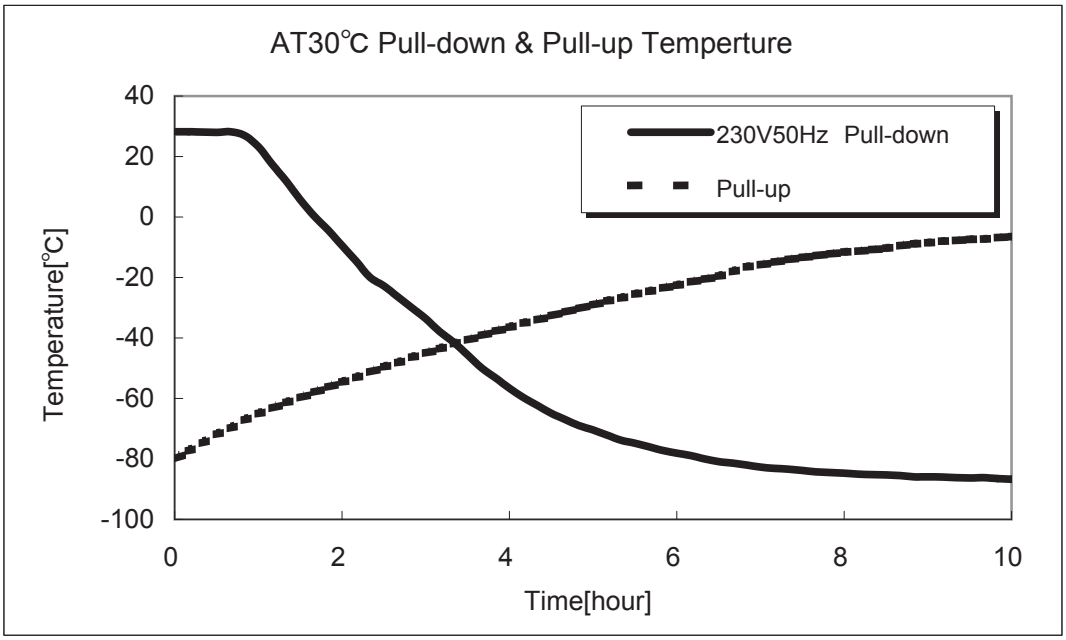
Temp. controller PCB

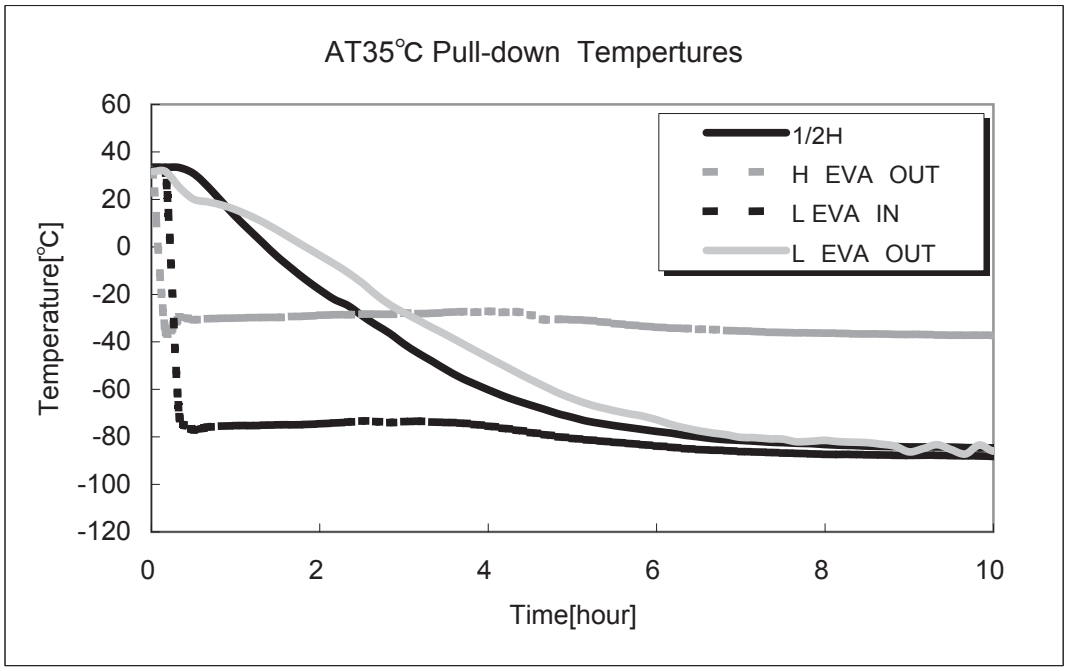
Running capacitor H

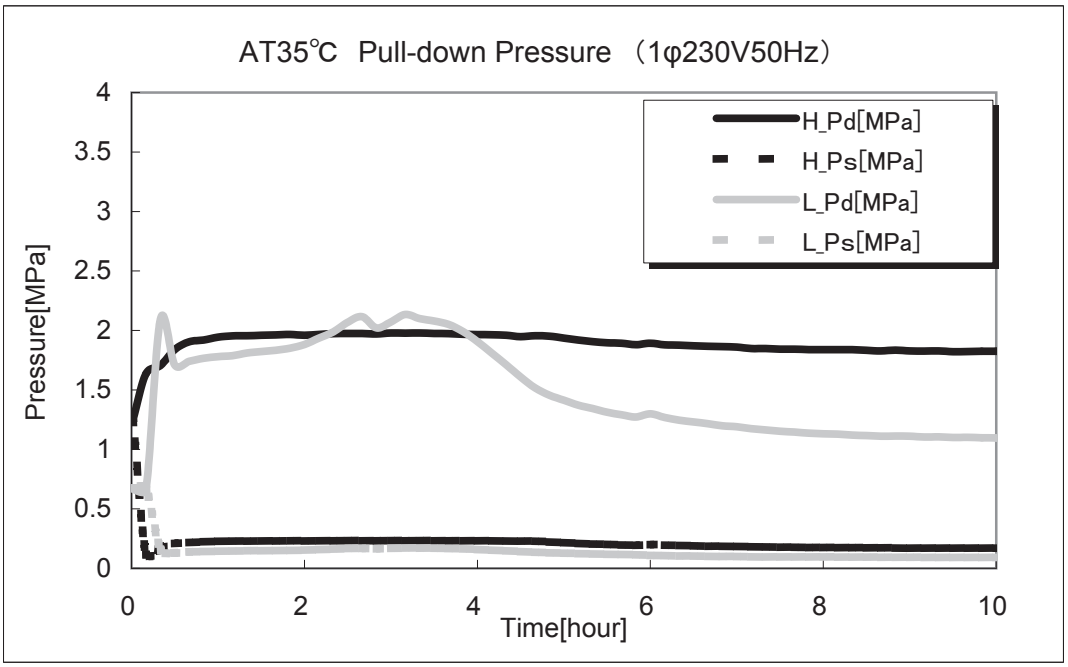
Switching power supply

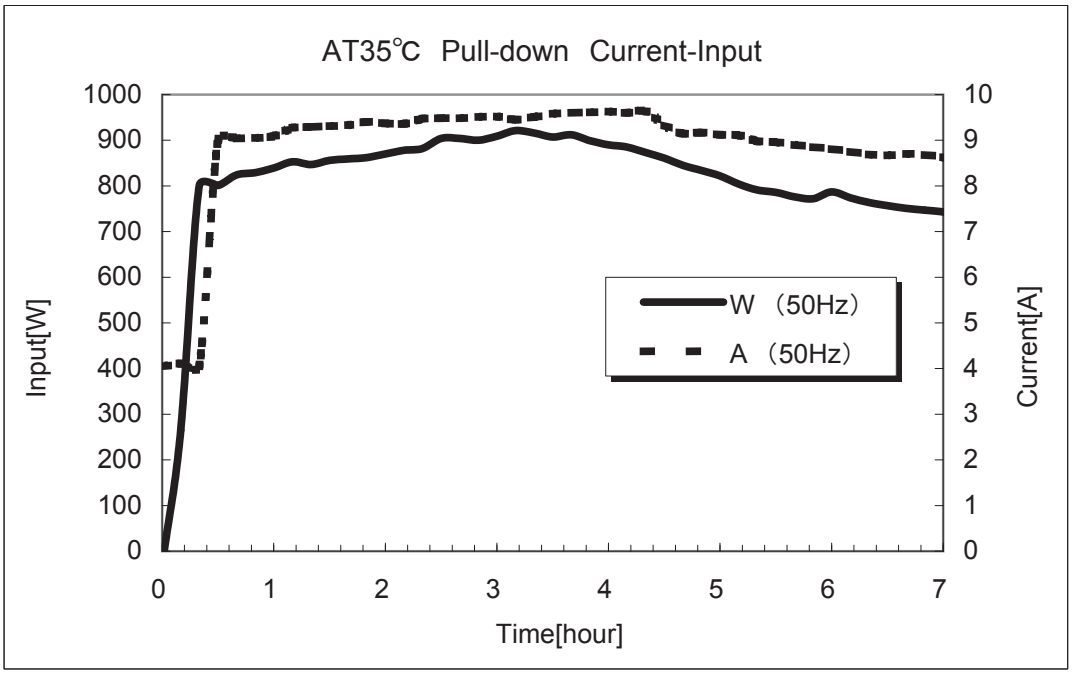
Test data

Note) Following data are the reference only.



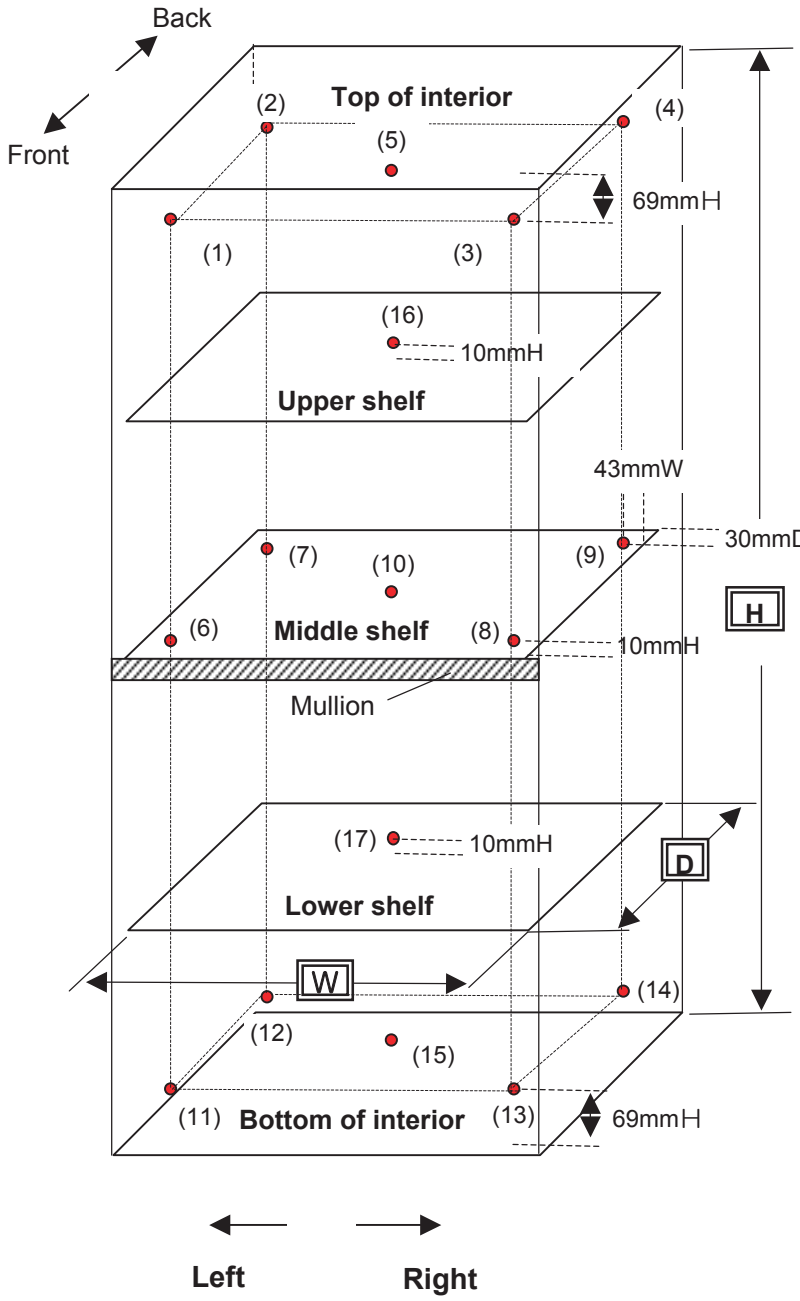



AT35℃ Pull-down Pressure （1φ230V50Hz）
Pressure[MPa]
Time[hour]
H_Pd[MPa]
H_Ps[MPa]
L_Pd[MPa]
L_Ps[MPa]
0
0.5
1
1.5
2
2.5
3
3.5
4
0
2
4
6
8
10


AT35℃ Pull-down Current-Input
Input[W]
Current[A]
Time[hour]
W （50Hz）
A （50Hz）
0
100
200
300
400
500
600
700
800
900
1000
0
1
2
3
4
5
6
7
8
9
10

Temperature uniformity - 17points measuring

Notes) These data are the reference only.



Upper area measuring points

(1)~(4): 69mm(H)lower from "Top of interior", 30mm(D) away and 43mm(W) away from each corner

(5): Center and 69mm(H) lower from "Top of interior"

(16): Center and 10mm(H) upper from "Upper shelf"

Middle area measuring points

(6)~(9): 10mm(H) upper from "Middle shelf", 30mm(D) away and 43mm(W) away from each corner

(10): Center and 10mm(H) upper from "Middle shelf"

Bottom area measuring points

(11)~(14): 69mm(H) upper from "Bottom of interior", 30mm(D) away and 43mm(W) away from each corner

(15): Center and 69mm(H) upper from "Bottom of interior"

(17): Center and 10mm(H) upper from "Lower shelf"

Temperature Uniformity (Reference Data)

＜Conditions＞

Ambient temperature: 20/30℃
Load: Unloaded

＜Temperature distribution＞
Temperature of the cycle in each area (SV=-80℃、air temperature)

Unit:℃

			Ambient temperature 20℃			
			230V/50Hz			
			Maximum	Minimum	Middle of cycle	Differential
①	Upper area	Left front	-75.7	-81.0	-78.4	±2.7
②		Left back	-77.7	-84.2	-81.0	±3.3
③		Right front	-73.7	-80.2	-77.0	±3.3
④		Right back	-77.0	-83.6	-80.3	±3.3
⑤		Center	-76.7	-81.7	-79.2	±2.5
⑥	Middle area	Left front	-78.1	-80.6	-79.4	±1.3
⑦		Left back	-80.0	-83.2	-81.6	±1.6
⑧		Right front	-78.0	-80.6	-79.3	±1.3
⑨		Right back	-79.8	-83.2	-81.5	±1.7
⑩		Center	-79.7	-81.9	-80.8	±1.1
⑪	Bottom area	Left front	-77.0	-79.4	-78.2	±1.2
⑫		Left back	-77.8	-80.6	-79.2	±1.4
⑬		Right front	-76.4	-78.5	-77.5	±1.1
⑭		Right back	-77.0	-79.9	-78.5	±1.5
⑮		Center	-78.3	-80.7	-79.5	±1.2
⑯	Center of Upper shelf		-80.0	-82.0	-81.0	±1.0
⑰	Center of Lower shelf		-80.0	-81.3	-80.7	±0.6
Average			-	-	-79.6	-

			Ambient temperature 30℃			
			230V/50Hz			
			Maximum	Minimum	Middle of cycle	Differential
①	Upper area	Left front	-75.0	-79.1	-77.1	±2.1
②		Left back	-76.8	-81.3	-79.1	±2.3
③		Right front	-74.7	-79.5	-77.1	±2.6
④		Right back	-76.8	-81.6	-79.2	±2.4
⑤		Center	-77.1	-82.2	-79.7	±2.4
⑥	Middle area	Left front	-77.7	-80.0	-78.9	±1.2
⑦		Left back	-79.5	-82.2	-80.9	±1.4
⑧		Right front	-77.4	-79.7	-78.6	±0.9
⑨		Right back	-79.3	-82.1	-80.7	±1.2
⑩		Center	-79.0	-80.7	-79.9	±1.4
⑪	Bottom area	Left front	-76.2	-79.1	-77.7	±1.5
⑫		Left back	-77.7	-80.9	-79.3	±1.6
⑬		Right front	-77.5	-80.9	-79.2	±1.5
⑭		Right back	-78.4	-82.0	-80.2	±1.7
⑮		Center	-78.4	-81.4	-79.9	±1.8
⑯	Center of Upper shelf		-78.8	-80.6	-79.7	±0.9
⑰	Center of Lower shelf		-79.5	-81.0	-80.3	±0.8
Average			-	-	-79.2	-

Note:This data does not represent a guarantee of product performance.

＜Amount of power consumption＞
Amount of power consumption when driving at cycl (SV=-80℃)

Unit:kWh/day

	Ambient temp. 20℃	Ambient temp. 30℃
	230V/50Hz	230V/50Hz
	11.08	12.63

＜Temperature distribution＞
Temperature of the cycle in each area (SV=-70℃、air temperature)

Unit:℃

			Ambient temperature 20℃			
			230V/50Hz			
			Maximum	Minimum	Middle of cycle	Differential
①	Upper area	Left front	-67.6	-74.7	-71.2	±3.6
②		Left back	-69.3	-78.3	-73.8	±4.5
③		Right front	-66.0	-73.3	-69.7	±3.7
④		Right back	-68.4	-77.2	-72.8	±4.4
⑤		Center	-68.0	-75.5	-71.8	±3.8
⑥	Middle area	Left front	-66.7	-70.3	-68.5	±1.8
⑦		Left back	-69.5	-75.0	-72.3	±2.8
⑧		Right front	-66.1	-69.6	-67.9	±1.8
⑨		Right back	-69.5	-74.3	-71.9	±2.4
⑩		Center	-68.8	-72.6	-70.7	±1.9
⑪	Bottom area	Left front	-62.4	-64.8	-63.6	±1.2
⑫		Left back	-64.3	-67.5	-65.9	±1.6
⑬		Right front	-61.7	-63.9	-62.8	±1.1
⑭		Right back	-62.1	-65.1	-63.6	±1.5
⑮		Center	-63.8	-66.1	-65.0	±1.2
⑯	Center of Upper shelf		-69.0	-72.7	-70.9	±1.9
⑰	Center of Lower shelf		-66.1	-67.7	-66.9	±0.8
Average			-	-	-68.7	-

			Ambient temperature 30℃			
			230V/50Hz			
			Maximum	Minimum	Middle of cycle	Differential
①	Upper area	Left front	-68.6	-77.4	-73.0	±4.4
②		Left back	-66.9	-73.9	-70.4	±3.5
③		Right front	-65.6	-72.9	-69.3	±3.7
④		Right back	-68.0	-76.5	-72.3	±4.3
⑤		Center	-67.5	-75.0	-71.3	±3.8
⑥	Middle area	Left front	-66.0	-69.8	-67.9	±1.9
⑦		Left back	-69.0	-74.6	-71.8	±2.8
⑧		Right front	-65.5	-69.0	-67.3	±1.8
⑨		Right back	-68.9	-74.0	-71.5	±2.6
⑩		Center	-68.2	-72.3	-70.3	±2.1
⑪	Bottom area	Left front	-61.3	-63.5	-62.4	±1.1
⑫		Left back	-63.4	-66.4	-64.9	±1.5
⑬		Right front	-60.5	-62.7	-61.6	±1.1
⑭		Right back	-61.1	-64.4	-62.8	±1.7
⑮		Center	-62.8	-65.0	-63.9	±1.1
⑯	Center of Upper shelf		-68.2	-72.0	-70.1	±1.9
⑰	Center of Lower shelf		-65.2	-67.0	-66.1	±0.9
Average			-	-	-68.0	-

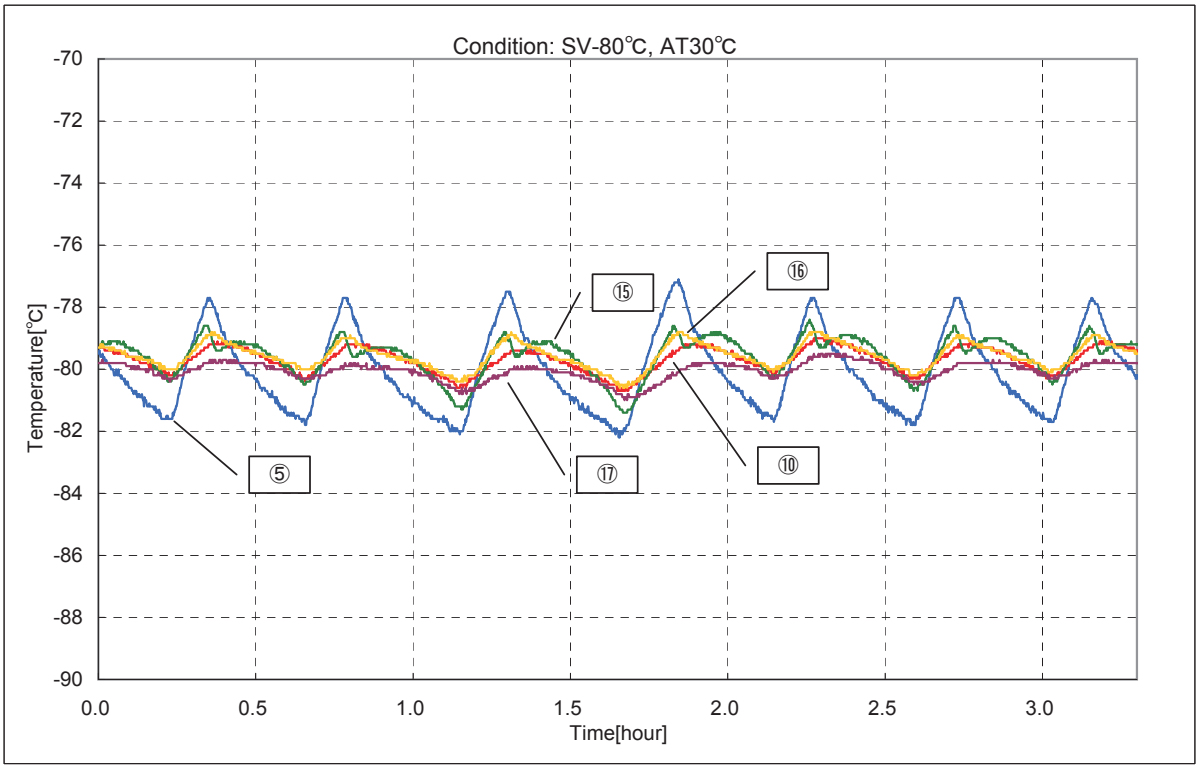
Note:This data does not represent a guarantee of product performance.

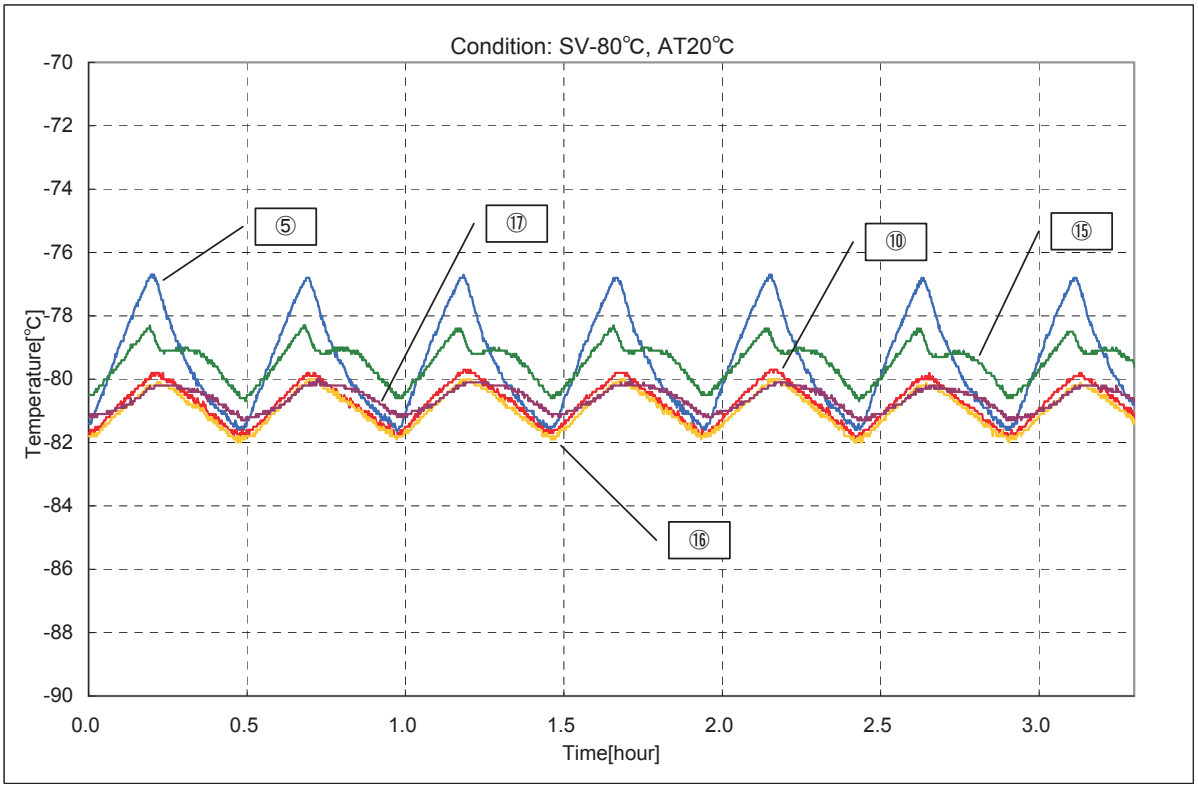
＜Amount of power consumption＞
Amount of power consumption when driving at cycl (SV=-70℃)

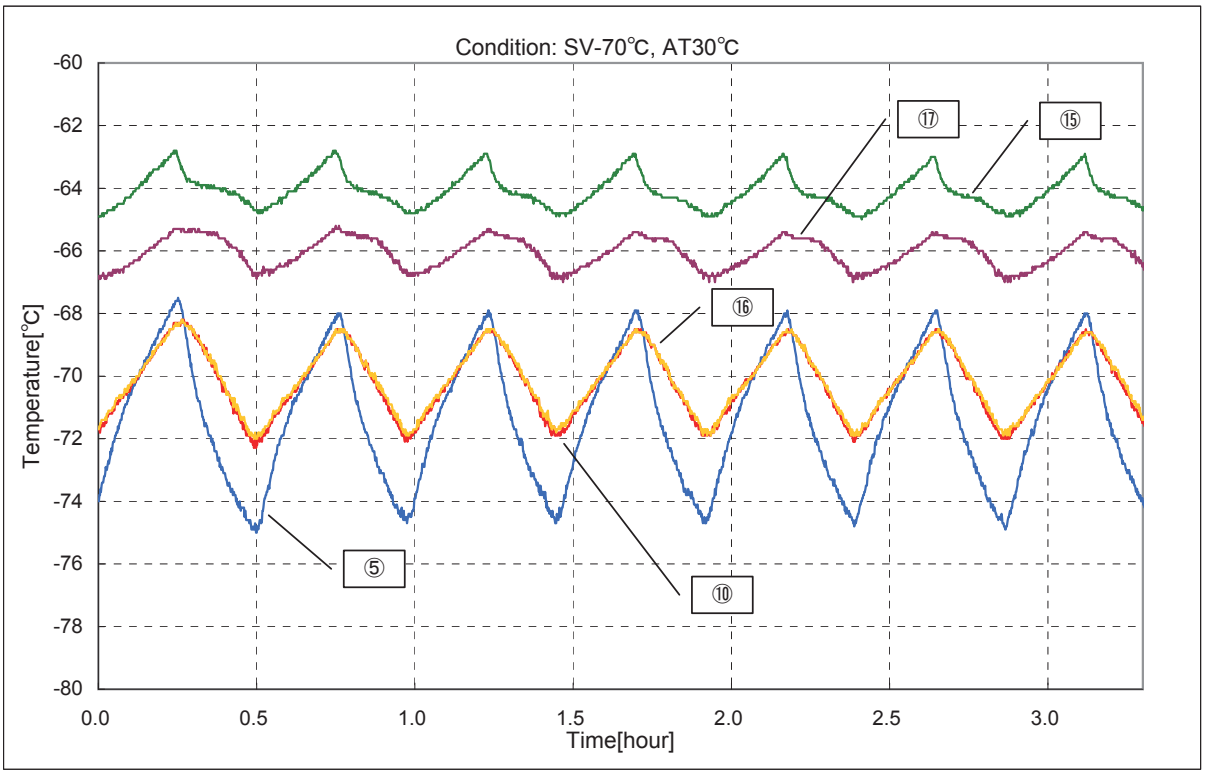
Unit：kWh/day

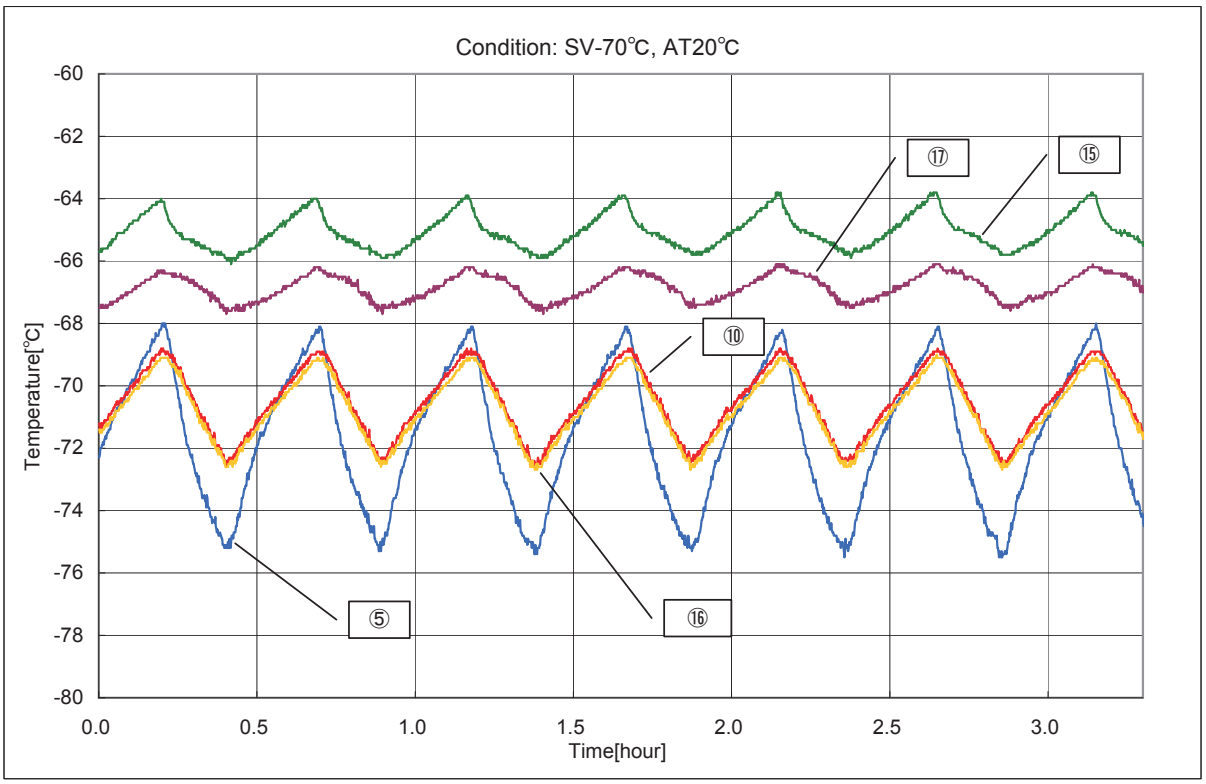
	Ambient temp. 20℃	Ambient temp. 30℃
	230V/50Hz	230V/50Hz
	8.57	9.96

<Temperatures during cycle operation>



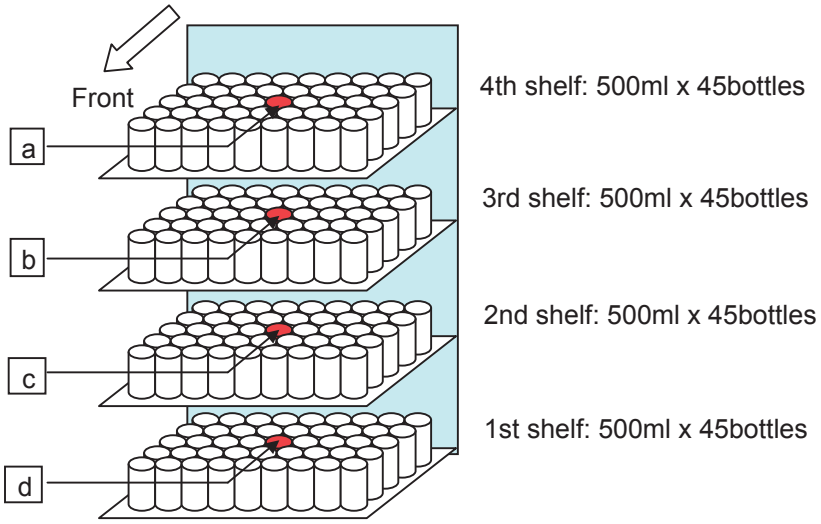


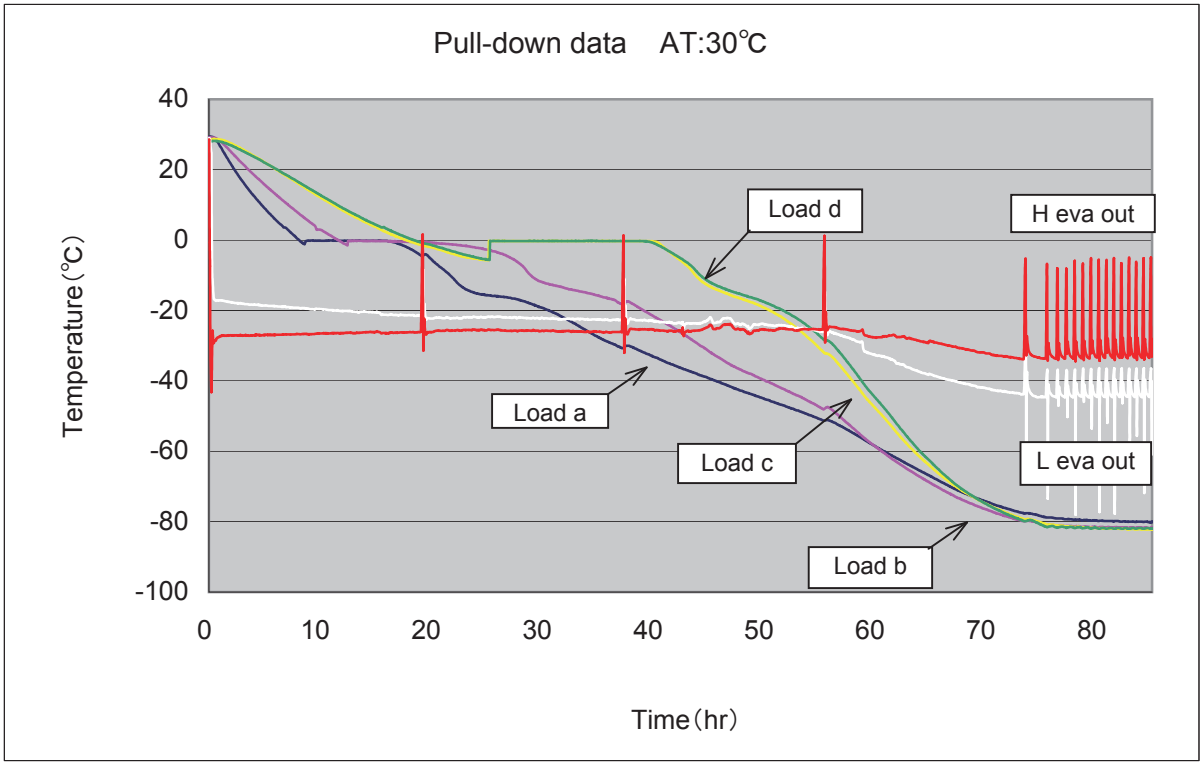

Condition: SV-70℃, AT30℃
Temperature[℃]
-60
-62
-64
-66
-68
-70
-72
-74
-76
-78
-80
0.0
0.5
1.0
1.5
2.0
2.5
3.0
Time[hour]
⑰
⑮
⑯
⑤
⑩

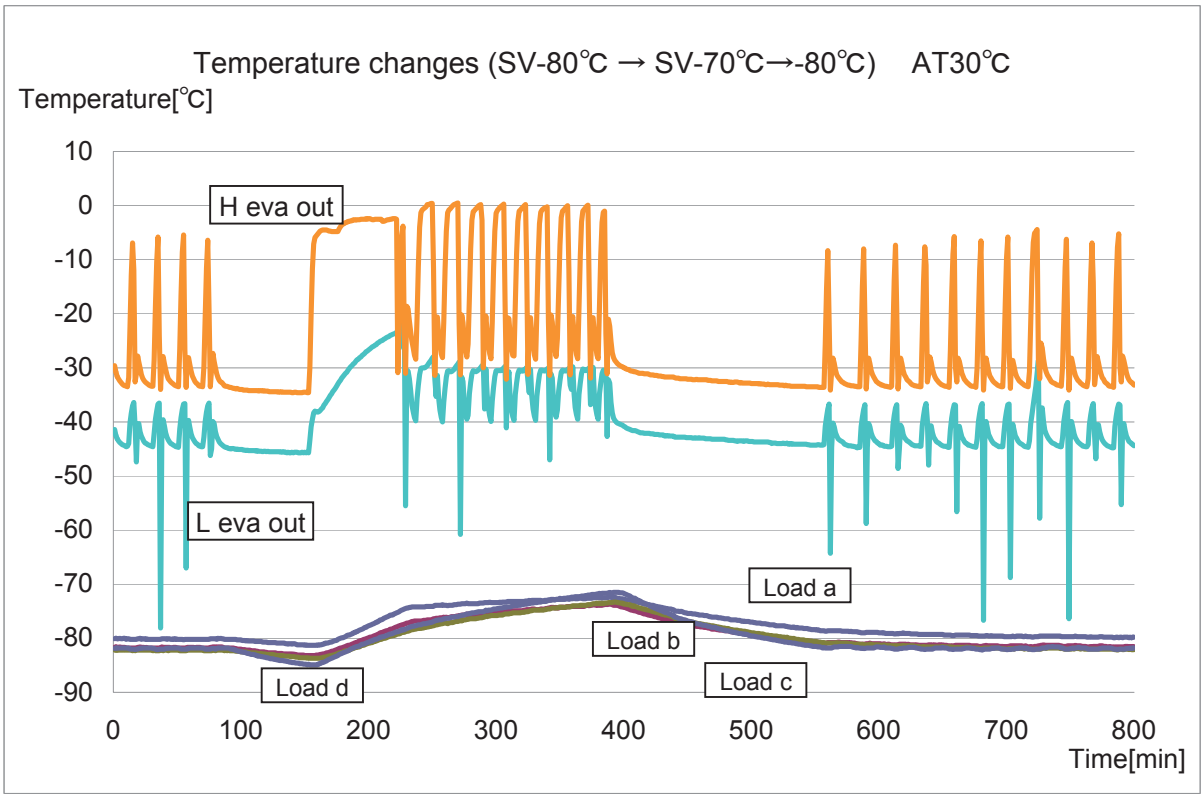

Condition: SV-70℃, AT20℃
Temperature[℃]
-60
-62
-64
-66
-68
-70
-72
-74
-76
-78
-80
0.0
0.5
1.0
1.5
2.0
2.5
3.0
Time[hour]
⑰
⑮
⑩
⑤
⑯

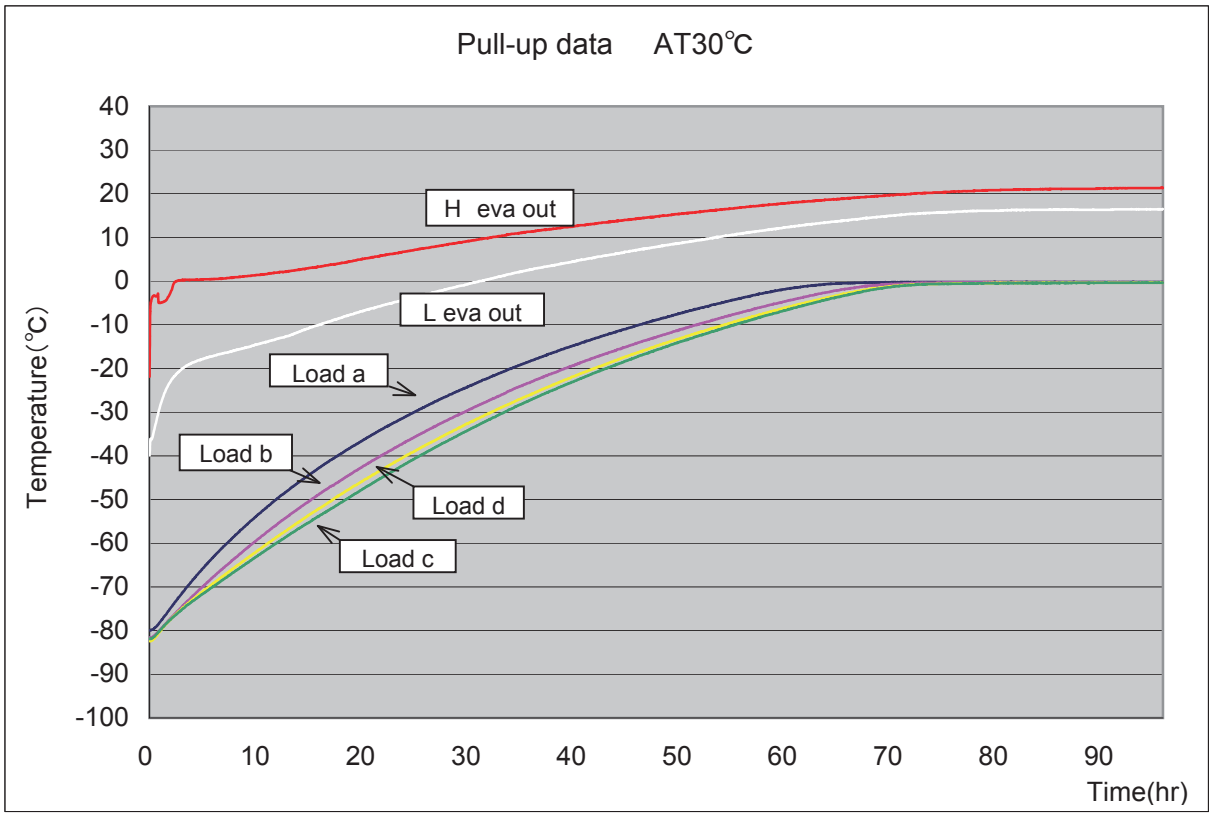
<Sample load test>

Conditions: 500ml water x 180 bottles（90L）
Measuring points: a, b, c, d, L eva-out, H eva-out
Ambient temperature: 30℃






Temperature changes (SV-80℃ → SV-70℃→-80℃) AT30℃
Temperature[℃]
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
H eva out
L eva out
Load a
Load b
Load c
Load d
0
100
200
300
400
500
600
700
800
Time[min]


Pull-up data AT30℃
Temperature(℃)
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
H eva out
L eva out
Load a
Load b
Load d
Load c
0
10
20
30
40
50
60
70
80
90
Time(hr)